Designing and developing a prototype Indigenous Knowledge Database and devising a Knowledge Management Framework.

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LIST OF ABBREVIATIONS

A

AACR	Anglo-American Cataloguing Rules
AIP	Archival Information Package
AIX	Advanced Interactive eXecutive
ANSI	American National Standards Institute
API	Application Programming Interface
ARIPO	African Regional Intellectual Property Office

C

CDM	Conceptual Data Model
CIRAN	Centre for International Research and Advisory Networks
CP	Community of Practice
CPU	Central Processing Unit
CSIR	Council for Scientific and Industrial Research

D

DBA	Database Administrator
DBLC	Database Life Cycle
DBMS	Database Management System
DDL	Data Definition Language
DIP	Dissemination Information Package
DM	Development Monitor
DML	Data Manipulation Language
DST	Department of Science and Technology

E

EFQM	European Foundation for Quality Management
ER	Entity-Relationship

ERM	Entity-Relationship Model

F

FOSS	Free and Open Source Software

G

GITOC	Government Information Technology Officers
GPS	Global Positioning System
GUI	Graphical User Interface

H

HTM	Hypertext Markup
HTML	Hypertext Markup Language

I

ICIK	Interinstitutional Consortium for Indigenous Knowledge
ICT	Information and Communication Technologies
IDRC	International Development Research Centre
IK	Indigenous Knowledge
IKS	Indigenous Knowledge Systems
ILO	International Labour Organization
INDAKS	Indigenous Agricultural Knowledge Systems
IP	Intellectual Property
IPC	International Patent Classification
IPR	Intellectual Property Rights
ISO	International Organization for Standardization
IT	Information Technology
IUCN	International Union for the Conservation of Nature and Natural Resources

K

KM	Knowledge Management

L

LEAD	Leiden Ethnosystems and Development Programme

M

MARC	Machine-Readable Cataloguing
METS	Metadata Encoding & Transmission Standard
MOA2	Making of America II
MODS	Metadata Object Description Schema
MRC	Medical Research Council

N

NCSA	National Centre for Supercomputing Applications
NGO	Non-Governmental Organization
NRF	National Research Foundation
NSW	New South Wales Government

O

OAIS	Open Archival Information System
OCLC	Online Computer Library Centre
OSS	Open Source Software

P

PBR	Plant Breeders Rights
PDM	Physical Data Model
PRA	Participatory Rural Appraisal

Q

QM	Quality Management

R

RDBMS	Relational Database Management System

S

SADC	Southern African Development Community
SANAS	South Africa National Accreditation Systems
SDLC	Systems Development Life Cycle
SICT	School of Information and Communication Technology
SIP	Submission Information Package
SQL	Structured Query Language
SRU	Search/Retrieval via URL

T

TKRC	Traditional Knowledge Resource Classification
TRAMED	Traditional Medicines database

U

UNESCO	United Nations Educational, Scientific and Cultural Organization
URL	Uniform Resource Locator
UWC	University of the Western Cape

W

WIPO	World Intellectual Property Organization

WHO	World Health Organisation
WWW	World Wide Web

X

XML	Extensible Markup Language

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STATEMENT REGARDING INDEPENDENT WORK

All extracts from other works have been acknowledged and the remainder is my own original work.

The dissertation or parts thereof has never before been:

(1) submitted for a qualification;

(2) rejected as a submission towards a qualification at the CUT or any other education institution; or

(3) rejected as a publication by a publishing house or journal.

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Leandra Jordaan

ABSTRACT

ENGLISH VERSION

The purpose of the study was to design and develop a prototype Indigenous Knowledge (IK) database that will be productive within a Knowledge Management (KM) framework specifically focused on IK. The need to develop a prototype IK database that can help standardise the work being done in the field of IK within South Africa has been established in the Indigenous Knowledge Systems (IKS) policy, which stated that "common standards would enable the integration of widely scattered and distributed references on IKS in a retrievable form. This would act as a bridge between indigenous and other knowledge systems" (IKS policy, 2004:33). In particular within the indigenous people's organizations, holders of IK, whether individually or collectively, have a claim that their knowledge should not be exploited for elitist purposes without direct benefit to their empowerment and the improvement of their livelihoods. Establishing guidelines and a modus operandi (KM framework) are important, especially when working with communities. Researchers go into communities to gather their knowledge and never return to the communities with their results. The communities feel enraged and wronged. Creating an IK network can curb such behaviour or at least inform researchers/organisations that this behaviour is damaging. The importance of IK is that IK provides the basis for problem-solving strategies for local communities, especially the poor, which can help reduce poverty. IK is a key element of the "social capital" of the poor; their main asset to invest in the struggle for survival, to produce food, to provide shelter, or to achieve control of their own lives. It is closely intertwined with their livelihoods.

Many aspects of KM and IK were discussed and a feasibility study for a KM framework was conducted to determine if any existing KM frameworks can work in an organisation that works with IK. Other factors that can influence IK are: guidelines for implementing a KM framework, information management, quality management, human factors/capital movement, leading role players in the field of IK, Intellectual

Property Rights (IPR), ethics, guidelines for doing fieldwork, and a best plan for implementation.

At this point, the focus changes from KM and IK to the prototype IK database and the technical design thereof. The focus is shifted to a more hands-on development by looking at the different data models and their underlying models. A well-designed database facilitates data management and becomes a valuable generator of information. A poorly designed database is likely to become a breeding ground for redundant data. The conceptual design stage used data modelling to create an abstract database structure that represents real-world objects in the most authentic way possible. The tools used to design the database are platform independent software; therefore the design can be implemented on many different platforms. An elementary prototype graphical user interface was designed in order to illustrate the database's three main functions: adding new members, adding new IK records, and searching the IK database. The IK database design took cognisance of what is currently prevailing in South Africa and the rest of the world with respect to IK and database development. The development of the database was done in such a way as to establish a standard database design for IK systems in South Africa. The goal was to design and develop a database that can be disseminated to researchers/organisations working in the field of IK so that the use of a template database can assist work in the field. Consequently the work in the field will be collected in the same way and based on the same model. At a later stage, the databases could be interlinked and South Africa can have one large knowledge repository for IK.

AFRIKAANSE WEERGAWE

Die doel met hierdie studie was om 'n prototipe databasis vir Inheemse Kennis (IK) te ontwerp en te ontwikkel wat binne 'n Kennisbestuursraamwerk, wat spesifiek op IK gefokus is, produktief sal wees. Die behoefte aan die ontwikkeling van 'n prototipe databasis vir IK, wat die werk wat in die IK-veld in Suid-Afrika gedoen word, kan help standaardiseer, is in die beleid oor Inheemse Kennisstelsels (IKS) vasgelê. Dit

verklaar dat “gemeenskaplike standaarde die integrasie van wydverstrooide en -verspreide verwysings oor IKS in ’n herwinbare vorm moontlik sal maak. Dit sou as ’n brug tussen inheemse en ander kennisstelsels gebruik kan word” (IKS beleid, 2004:33). Houers van IK, hetsy individueel of gesamentlik, het veral binne die inheemse volke se organisasies ’n eis dat hulle kennis nie vir elitistiese doeleindes gebruik behoort te word sonder dat hulle direk deur bemagtiging en die verbetering van hulle lewensonderhoud daaruit voordeel trek nie. Dit is belangrik om riglyne en ’n modus operandi (kennisbestuursraamwerk) daar te stel, veral wanneer ’n mens met gemeenskappe werk. Navorsers gaan na gemeenskappe toe om hulle kennis te versamel en keer nooit met die resultate na die gemeenskappe terug nie. Die gemeenskappe voel kwaad en verontreg; om 'n IK-netwerk te skep, kan sulke gedrag aan bande lê of ten minste navorsers/organisasies inlig dat hierdie gedrag skadelik is. Die belang van IK is dat IK die grondslag vir probleemoplossende strategieë vir plaaslike gemeenskappe lê, wat veral vir die armes armoede kan help verlig. IK is ’n kernelement in die “sosiale kapitaal” van die armes; hulle belangrikste bate om in die stryd om oorlewing te belê om kos te produseer, skuiling te bied of beheer oor hulle eie lewens te verkry. Dit hou nou met hulle lewensonderhoud verband.

Baie aspekte van kennisbestuur en IK is bespreek en ’n uitvoerbaarheidstudie vir ’n kennisbestuursraamwerk is gedoen om te bepaal of enige bestaande kennisbestuursraamwerk in ’n organisasie wat met IK werk, sal werk. Ander faktore wat bespreek is, wat IK kan beïnvloed, is riglyne vir die implementering van ’n kennisbestuursraamwerk, inligtingsbestuur, gehaltebestuur, die menslike faktore/kapitaalbeweging, leidende rolspelers op die gebied van IK, Intellektuele Eiendom Reg (IER), etiek, riglyne om veldwerk te doen en ’n beste plan vir implementering.

Op hierdie punt verskuif die fokus van kennisbestuur en IK na die prototipe databasis vir IK en die tegniese ontwerp daarvan. Die fokus word verskuif na ’n praktiese ontwikkeling deur na die verskillende datamodelle en hulle onderliggende modelle te kyk. ’n Goed ontwerpte databasis fasiliteer databestuur en word ’n waardevolle voortbrenger van inligting. ’n Swak ontwerpte databasis sal waarskynlik ’n teelaarde

vir oorbodige data word. Die konseptuele ontwerpfase het datamodellering gebruik om ’n abstrakte databasisstruktuur te skep wat objekte in die werklike wêreld op die mees outentieke manier moontlik weergee. Die databasis is ontwerp deur platform-onafhanklike sagteware te gebruik. ’n Elementêre prototipe grafiese koppelvlaktoestel vir gebruikers is ontwerp ten einde die databasis se drie hooffunksies te illustreer: om nuwe lede by te voeg, om ’n nuwe IK-rekord by te voeg en om deur die IK-databasis te soek. Die ontwerp van die IK-databasis het kennis geneem van wat tans in Suid-Afrika en die res van die wêreld voorkom wat IK en databasisontwikkeling betref. Die databasis is op so ’n manier ontwikkel dat ’n standaard databasisontwerp vir IK-stelsels in Suid-Afrika daargestel is. Die doel was om ’n databasis te ontwerp en te ontwikkel wat aan navorsers/organisasies wat in die IK-veld werk versprei kan word sodat die gebruik van ’n templaatdatabasis werk in die veld kan help. Die gevolg hiervan is dat die werk in die veld op dieselfde manier versamel sal word en op dieselfde model gegrond sal wees. Die databasisse sou op ’n later stadium aaneengekoppel kon word en Suid-Afrika sou een groot versamelplek vir IK kan hê.

CHAPTER 1

Introduction

1.1. BACKGROUND

The purpose of the study is to design and develop a prototype Indigenous Knowledge (IK) database that will be appropriate and productive within a Knowledge Management (KM) framework specifically focused on IK. The design of the IK database will obviously take cognisance of what is currently prevailing in South Africa and the rest of the world with respect to IK and database development. The development of this database will be done in such a way as to establish a standard database design for IK systems in South Africa. The database must be flexible in some aspects to allow researchers to add fields where necessary, with the understanding that such practices must first be communicated to the governing body of the IK database. Informing the governing body of such practices ensures that all databases will be kept on the same level, therefore enabling the databases to be interlinked and have one large knowledge repository for IK in South Africa. This of course is a long-term goal.

Since the eighties, a movement that is known as the “cultural turn” in knowledge production has laid greater emphasis on the socio-landscape of knowledge. Although IK awareness existed before this date, the recognition and integration of IK into systems of knowledge has taken momentum in the eighties and has been linked to the cultural turn. The underlying assumptions are twofold: on the one hand, it is believed that knowledge closest to the life environment of people (sometimes ignored or discarded for years) has the best chance of becoming integrated and internalised with the meaning systems of people, in particular local communities. On the other hand, from project lessons in development, it was learnt that IK has an important contribution to make and it can prevent expensive failures when working with local communities. (Sillitoe *et al.*, 2005:8-11). In particular within the indigenous people’s

organizations, holders of IK, whether individually or collectively, have a claim that their knowledge should not be exploited for elitist purposes without direct benefit to their empowerment and the improvement of their livelihoods.

The above is illustrated by Thomas L. Friedman, who argues in his book *The World is Flat* that, “to the great chagrin of reactionaries, it has drawn from under the feet of industry the national ground on which it stood. All old-established national industries have been destroyed or are daily being destroyed. They are dislodged by new industries, whose introduction becomes a life and death question for all civilised nations, by industries that no longer work up indigenous raw material, but raw material drawn from the remotest zones; industries whose products are consumed, not only at home, but in every quarter of the globe” (Friedman, 2006:236). This book deals with globalisation and is, to some extent, positive about globalising developments, but indigenous peoples have to guard against losing their indigenous culture and have to preserve their unique diversity for coming generations. Therefore, the development of an IK database could be a good solution for the preservation of heritage.

1.2. STATEMENT OF THE PROBLEM

The national initiatives regarding the promotion and mainstreaming of IK have accentuated the dire need for a comprehensive IK database that will also be accessible to local communities and not only for sophisticated academic use.

Several IK databases have been developed in various fields. The problems encountered with the IK databases are:

a. community access: When referring to the user-friendliness of certain technologies for use in local communities, consider the social implications and effects the technology will have on the community itself. Information and Communication Technologies (ICT) are the products of Western reductionist science and as such, they represent a pragmatic solution within a Western social context, which might not be appropriate in a cultural context rich in myth, symbolism, and the

mysterious. Therefore, because technology in the Western definition is infused with Western cultural values and English linguistic conceptualisation, it is inaccessible to cultures with different thought systems. In South African rural communities' access is further restricted by a lack of human capacity such as literacy, proficiency in English, technical and computer competence, urban/rural inequalities, gender inequalities; affordability; and a lack of relevant information content (Moodley, 2005:8);

b. the lack of KM that allows for the selective retrieval of information; and
c. no facility to add new data once the database has been launched and
d. no management of the knowledge already in the database.

The lack of standardised classification schemas for IK, as well as the lack of generally accepted taxonomies, also complicates the design of an IK database. Although no intention exists to solve this complex issue, the envisaged establishment of a KM framework will have to suggest possible strategies to deal with this crucial issue, because it relates to the design of the database.

Access too many of the existing IK databases are severely restricted, if not totally unavailable. The reason for this unavailability is that the information gathered and placed in the database is still the property of the community. Intellectual Property (IP) laws therefore prohibit freely dispensing the knowledge to the general population, large companies, etc.

Knowledge in the database collected from communities, stakeholders, etc. is lost because it is not tagged and it is stored incorrectly. Key players leave the field at an alarming rate, which results in unfinished data products. Field work and database development are duplicated because there is no coordination between researchers in the field.

Finally, because researchers are not collaborating, no correlation exists between existing databases either; therefore information becomes stagnant.

1.3. THE CLARIFICATION OF CONCEPTS

Indigenous Knowledge (IK) – This term refers to the unique, traditional, local knowledge existing within and developed around the specific conditions of women and men indigenous to a particular geographic area. IK can also be referred to as traditional knowledge or local knowledge (Grenier, 1998:1-3).

Indigenous Knowledge Systems (IKS) – Many definitions are provided for this field, and as such, it is better to define the field by its salient features. IK is varied and could relate to any domain; it is embedded in the socio-cultural tradition to which a person is exposed from birth and will determine how that person interacts with his or her environment; it is based in communities and preserved in its local cultural traditions; the distribution is fragmentary and cumulative and while it is widely shared, does not reside in any one community or person; it is nowhere preserved in its totality and comprises both knowledge and skill that are inherited orally, through experience, and daily repetition between consecutive generations (Sillitoe *et al.*, 2005:3-4).

Indigenous Knowledge Holder – This refers to persons who have knowledge about their community. The knowledge is based on experience and adaptation to a local culture and environment. This IK holder's information has developed over time and keeps developing. The knowledge of the IK holders sustains the community and its culture and maintains the genetic resources necessary for the continued survival of the community (Hansen & VanFleet, 2003:3).

Indigenous Knowledge Community – IK is collective in nature and is often considered the property of an entire community, not belonging to a single individual within the community (Hansen & VanFleet, 2003:3).

Traditional Medicine – Traditional medicine is the sum total of knowledge, skills and practices based on the theories, beliefs and experiences indigenous to different cultures that are used to maintain health, as well as to prevent, diagnose, improve or treat physical and mental illnesses (World Health Organisation, 2009).

Knowledge Management (KM) – KM is a systematic and organised approach to improve the organisation's ability to mobilise knowledge in order to enhance performance. KM recognises the value of originality, innovation, agility, adaptability, intelligence, and learning. It seeks to leverage the capacity of the organisation in these areas, and is concerned with critical thinking, innovation, relationships, exposure to ideas, patterns, competencies, and collaboration (Gu, 2004:285).

Knowledge Management Framework – The goal of a KM framework is to offer a framework for balancing a myriad of technologies and approaches that provide value, tying them together into a seamless whole. It helps analysts and designers better to address the interests of stakeholders across interrelated knowledge flows and, by doing so, better to enable individuals, systems, and organisations to exhibit truly intelligent behaviour in multiple contexts (Newman & Conrad, 1999:2).

Knowledge Artefact – It flows among and forms the links between the activities and events that comprise knowledge flow. Artefacts come in a variety of forms: documents, files, papers, conversations, pictures, thoughts, software, databases, e-mail messages, data sets, winks and nods, and whatever else can be used to represent meaning and understanding. The term knowledge artefact does not specify the form of the artefact, but it is very specific as to the process that gave rise to the artefact (Newman & Conrad, 1999:5).

Knowledge Sharing – This is the sharing or exchange of knowledge. Knowledge which is created in the mind of the individuals is generally of little value to an organisation unless it is shared (Small & Sage, 2005/2006:156).

Socio-Cultural – The term signifies the mutually interdependence of cultural and society as dimensions of reality (Nel, 2007:4).

1.4. OBJECTIVES OF THE STUDY

The goal of this study is to analyse and define the problems and constraints of the organisational/community situation relevant to IK data collection, in particular in view of compiling a database for it. The study aims to determine the best course of action for designing and developing a standardised prototype IK database to be used as a template database by as many people as possible working on IK in South Africa. The current consensus is that the most proper mode of preserving IK is by recording the information in specialised databases. It is therefore important to conduct a study into what the best design for such a database would be. The scope for establishing such a database is to allow researchers to work on one template database that can be linked together or merged in order to form one large IK network in South Africa that will advance the protection given to communities and their IK. This study will assess the possible issues that can arise from developing such a database in a cultural sensitive field such as IK.

The objectives of the study are to design and develop a prototype IK database and to include a study of existing KM frameworks in order to determine what KM framework would be best suited to the IK database, if any. The main purpose of the study is to establish a standard database design for IK systems in South Africa. In the next section the limitations will be discussed.

1.5. ASSUMPTIONS

The supposition is that the need for the design of such a database exists, and this is underscored by the explicit expectation of the National Policy Document of IKS that was adopted by cabinet in November 2004 (IKS policy, 2004:3). The policy document states that the methodology and standards used in the creation of IK databases should be harmonised with other international systems so that cross-referencing is possible. The policy document also states that the creation of IK databases should serve a wider purpose in providing and enhancing its innovation capacity, bearing in mind, of course, the IK protection mechanisms described in Section 6.2 of the IKS

policy. The document goes on to state that common standards would enable the integration of widely scattered and distributed references on IKS in a retrievable form (IKS policy, 2004:33).

The first assumption is that an IK framework is in place and, therefore, knowledge can be retrieved from the identified rural communities and stakeholders.

The second assumption is that in accepting the existence of such a framework, it is also accepted that a governing authority (currently the mandate is with the Department of Science and Technology) exists to which all parties involved in developing IK databases report and that this body will put in place a plan of action.

The third assumption is that a resolution can be agreed upon by all parties concerning the Intellectual Property (IP) of the knowledge and copyright restrictions.

The final assumption is that, although an IKS policy is in place, there has been no success thus far in establishing a KM framework together with an IK database.

The study will not attempt to predict the success of field work done in the different fields/domains.

1.6. SIGNIFICANCE

Conventional theories of development have always implied a transfer of technology and resources from more advanced places or nations to less advanced places or nations (World Bank 1(d), 2006). Joseph Stilglitz emphasises the need for giving employees/citizens incentives to develop their own capacities and confidence in using their own intelligence to empower change and learning activities (Stilglitz cited in Mchombu, 2007:26). In spite of billions of dollars of foreign aid having flown into Africa since the 1960s, it is the poorest continent, with sub-Saharan Africa being the lowest income region in the world (Collier & Gunning, 1999:3-4). Development has become increasingly focused on finding initiatives that are endogenous to the places

in need of development rather than the conventional top-down model. The key phrase has become participatory development and it calls for community participation in the design and implementation of development-related initiatives (Botes, 1999:41-49). The accommodation of the relevance of the database for the local community is aligned towards this concern for community development.

IK has been identified by organisations such as the World Bank for its crucial contribution to sectors and strategies including agriculture, animal husbandry and ethnic veterinary medicine, the use and management of natural resources, primary health care, preventative medicine and psychosocial care, saving and lending, community development, and poverty alleviation (World Bank 1(d), 2006). The value that IKS could have in the development of the rural poor is increasingly acknowledged, but is "not yet fully utilized in the development process" (World Bank 1(d), 2006). In a paper *Africa's transition to the 21st century* written by Kingo Mchombu, he lists ways to address the knowledge deficit in Africa. One of the ways is creating knowledge locally. He states that "the creation of knowledge locally should include tapping into indigenous knowledge resources that the population has, to assist in development activities" (Mchombu, 2007:30).

CHAPTER 2

Knowledge Management Framework

2.1. INTRODUCTION

IK is important because it provides the basis for problem-solving strategies for local communities, especially the poor, which can help reduce poverty. IK is a key element of the “social capital” of the poor; it is their main asset to invest in the struggle for survival, to produce food, to provide shelter, or to achieve control of their own lives. It is closely intertwined with their livelihoods.

IK represents an important component of global knowledge on development issues. IK is an underutilised resource in the development process. Learning from IK, by investigating first what local communities know and have, can improve understanding of local conditions and provide a productive context for activities designed to help communities. Sharing IK within and across communities can help enhance cross-cultural understanding and promote the cultural dimension of development (World Bank 1(d), 2006).

IK is of particular importance in the following sectors/strategies: agriculture, animal husbandry and ethnic veterinary medicine, the use and management of natural resources, primary health care, preventive medicine and psycho-social care, saving and lending, community development, and poverty alleviation. It should be noted that not all indigenous practices are beneficial to the sustainable development of a local community and not all IK can provide the right solution for a given problem (World Bank 1(d), 2006).

Throughout this chapter, many aspects of KM and IK will be discussed. A feasibility study on KM frameworks will be conducted to determine if any existing KM frameworks can feasibly be utilised in an organisation that works with IK. Other

factors that have an influence on IK that will be discussed are guidelines for implementing a KM framework, information management, quality management, human factors/capital movement, leading role players in the field of IK, Intellectual Property Rights (IPR), ethics, guidelines for doing fieldwork, and a best plan for implementation. These are just some of the major factors to be kept in mind when working with KM and IK.

An in-depth research methodology is needed since IKS have been ignored and even ridiculed during the colonial era, in which 'primitive people' and their knowledge systems were often subordinated to Western knowledge and technology from colonial powers. Moreover, as these systems tend to disappear rapidly in view of current processes of modernisation and westernisation, there is an urgency to document IK systems for the future (Slikkerveer, 1997:18).

2.2. TACIT AND EXCPLICIT KNOWLEDGE

The first chapter briefly referred to the two types of knowledge's: tacit knowledge and explicit knowledge. Tacit (also called intangible) knowledge is defined as personal knowledge based on individual experience, insights and intuition, while explicit knowledge is formal and written (Nonaka cited in Mchombu, 2007:25).

The concept of these two types of knowledge's was first suggested by Nonaka & Takeuchi in 1995 in a work called *The Knowledge-Creating Company*. Nonaka & Takeuchi criticised Western management and organisation theorists for being preoccupied with "the acquisition, accumulation, and utilisation of existing knowledge" (Nonaka & Takeuchi cited in Sveiby, 1997:47).

In their book, Nonaka and Takeuchi described four processes for the conversion of tacit and explicit knowledge which they believe are crucial to creating value (Abell & Oxbrow, 2001:45) and Karl Sveiby (1997:47) graphically represented these processes in his book as seen in Figure 2.1.

		TO	
		Tacit Knowledge	Explicit Knowledge
FROM	Tacit Knowledge	Socialisation	Externalisation
	Explicit Knowledge	Internalisation	Combination

Figure 2.1 Four modes of knowledge conversion

The four processes for the conversion of knowledge are:

- tacit-to-tacit (socialisation): where individuals directly share and test knowledge;
- tacit-to-explicit (externalisation): the transformation of knowledge into a tangible form through documentation or discussion;
- explicit-to-explicit (combination): combining different forms of explicit knowledge such as documents or databases; and
- explicit-to-tacit (internalisation): where individuals internalise knowledge from documents, discussion, or learning into their own body of knowledge (Abell & Oxbrow, 2001:45).

The processes stated above indicates that tacit-to-tacit knowledge will be the more social knowledge process that have to do with people and their culture and thus will be the more appropriate knowledge process when looking at IK in its current "unrecorded" form, where knowledge is conveyed from person to person, mostly. The aim is, however, to transform the orally carried knowledge into a tangible documented form i.e. the IK database, and therefore, the tacit-to-explicit knowledge process will be the next step. The reason for including information about tacit and explicit knowledge and the processes they have in this chapter is that when compiling the KM framework and developing the database for IK both these types will play a role. The idea is that by developing a database for IK, tacit knowledge will be converted into explicit knowledge.

2.3. INDIGENOUS KNOWLEDGE

The term indigenous and thus the concept of indigenous knowledge have often been associated in the Western context with the primitive, the wild, the natural. However, for others, especially the millions of indigenous people of Africa, Latin America, Asia, and Oceania, IK (or what others have called the native ways of knowing) is an everyday rationalisation that rewards individuals who live in the given locality. In part, to these individuals, IK reflects the dynamic way in which the residents of an area have come to understand themselves in relationship to their natural environment and how they organise that folk knowledge of flora and fauna, cultural beliefs, and history to enhance their lives (Semali & Kincheloe, 1999:3).

In 1996 and 1997, the Inter institutional Consortium for Indigenous Knowledge (ICIK) held two conferences. One of the outcomes of these conferences was that educators, scientists, and students came to the realisation that IK does not exist in a vacuum, that it belongs to a community, and that access to this knowledge is gained through contact with the community (Semali & Kincheloe, 1999:5). The importance of community involvement cannot be overemphasised; they are the knowledge holders and users, and the entire purpose of the development of the IK database is to conserve their knowledge. One thing that scholars should be very careful of is that they can easily overstep the boundaries, and instead of helping indigenous people, they might marginalise them further. The best example of such a case and/or perhaps the most well known is described by Joe Kincheloe and he says “such a vampirism sucked the blood of indigenous suffering out of the veins of the Native Americans, in the process of contributing little to the larger cause of social justice. The only struggle in which many of these vampires engaged was a personal quest for a new identity”, (Semali & Kincheloe, 1999:20). Another issue that is raised in the text is when he states “…like other indigenous peoples understood the dangers of Western “help” – the questions must be asked, is the study of indigenous peoples and their knowledge’s in itself a process of Europeanisation? In some ways, of course, it is, as western intellectuals conceptualise IK in contexts far removed from its production. In other ways, however, western intellectuals have little choice; if they are to operate as agents of justice, they must understand the dynamics at work in the world of the

indigene" (Semali & Kincheloe, 1999: 20). We have to constantly keep ourselves in check by asking whether we are contributing to their lives with our work or whether are we doing this work only for our own gain.

Another subject for deliberation is the difference between Indigenous Knowledge and Western Science. Western Science might be seen as better (the new technologies and sciences), but in fact, they are both important to us in different ways and that setting them against each other is erroneous. Western Science [knowledge] have sought to reduce reality to its most fundamental laws, its most fundamental particles. The object of the game has been to work back from the complex to the simple and then derive from those fundamental laws and fundamental particles more complex laws and systems (Schoenhoff, 1993:28). The description of Western Science given by Schoenhoff highlights one primary difference between the two forms of knowledge and that is: Western Science is well documented, while IK is not. IK is transferred orally from one community member to another. The irony of the matter is that Western Science is not an essentially European achievement, as knowledge interchanges between Europe and various non-Western cultures had taken place for hundreds of years preceding the Western enlightenment. Scientific and technological ideas and inventions traditionally attributed to the West include China's magnetic science, cast iron, the mechanical clock, and harnesses for horses, as well as Polynesia's knowledge of navigation and sea currents (Semali & Kincheloe, 1999:25). In an article written by Arun Agrawal, the author states that separating the two types, IK and Western Science, is impossible. He says that "the classification into indigenous and western knowledge [science] fails not only because there are similarities across these categories and differences within them. In the face of evidence that suggests contact, diversity, exchange, communication, learning, and transformation among different systems of knowledge beliefs (Levi-Strauss, Wallerstein & Wolf cited in Agrawal, 2004), it is difficult to adhere to a view that separates indigenous and scientific/western knowledge" (Agrawal, 2004:3). Therefore, it can be said that a fundamental difference is that Western Science is well documented while IK is not, but apart from that, they are both an integral part of our world's societies, and we cannot exist without either IK or Western Science.

Finally, let's discuss the characteristics of IK. IK is stored in peoples' memories and activities and is expressed in stories, songs, folklore, proverbs, dances, myths, cultural values, beliefs, rituals, community laws, local language and taxonomy, agricultural practices, equipment, materials, plant species, and animal breeds (Grenier, 1998:2). According to the Management of Social Transformations programme (MOST) and the Centre for International Research and Advisory Networks (CIRAN)'s joint publication, the following items are characteristic of IK:

- IK is generated within communities;
- IK is location and culture specific;
- IK is the basis for decision making and survival strategies;
- IK is not systematically documented;
- IK concerns critical issues of human and animal life: primary production and natural resource management;
- IK is dynamic and based on innovation, adaptation, and experimentation; and
- IK is transmitted orally and is rural in nature (MOST & CIRAN, 1999).

When looking at the new world of high-speed advancement in which we live, it is impossible and unwarranted to become entirely detached from modern science and new technologies. The reasoning should, however, not be that new technologies are the only technologies in existence. Rural cultures have been using indigenous technologies, for instance clay pottery, agricultural tools, and water management for years, centuries even. The indigenous technologies are part of people's existence just as much as new technologies have now become part of ours, and the question that should be asked and answered is whether our new technologies will enhance indigenous people's way of living. As Nel states, "New technology should enhance the sense of belonging and embeddedness and foster the values of wellness in an integrated manner with the meaning and symbolism of the socio-cultural landscape" (Nel, 2007:2-5). The answer to the question whether new technologies enhance the way of living of indigenous people might be that, rather than deciding in favour or against new technologies on behalf of an indigenous community, to involve them in the decision. Let us presume for the sake of argument (and this dissertation) that the

communal decision is that new technology such as a database to preserve IK will enhance their way of living or at least preserve their IK for future generations.

Before looking at how to design, develop, and implement an IK database to accommodate the knowledge that will be gathered, we need to ensure that the organisation responsible for this task has a framework for managing its organisational knowledge as well as a framework/model for overseeing the IK. If this framework(s) is not in place, starting with fieldwork will be detrimental to any project undertaken. IK is more than a simple compilation of facts drawn from local, and often remote, environments. It is a complex and sophisticated system of knowledge drawing on centuries of wisdom and experience. It also constantly grows and changes with new information. To use these systems, one must include the indigenous people themselves as practitioners, and therefore, it is imperative that framework(s) are in place to guide the organisation in working with indigenous people to achieve the best results possible (Emery, 2000:3). Before looking at how to develop such a framework, the five best KM models ought to be discussed to determine which models will be involved in the KM framework.

2.4. THE FIVE BEST KNOWLEDGE MANAGEMENT MODELS

The terms “data”, “information” and “knowledge” are often used interchangeably in the literature and in practice, but a distinction must be made between the three. The best way to perhaps describe data, information, and knowledge is that data are just characters and numbers without any sense of order, for instance: “18 John Leary”. From this data, one cannot ascertain whether it is a statement, i.e. John Leary is 18, or whether it is perhaps part of an address. More data is needed to reach a conclusion: “18 John Leary Street, Dan Pienaar, Bloemfontein, 9301”. It now becomes clear that, in fact, the data is part of an address. This is *information*. Assumptions can be made and conclusions drawn from this given information; it can be internalised. Once this information is memorised and made part of the “human” database (the brain), it becomes *knowledge.* Knowledge is reworked and memorised and no one can take the knowledge away. These three concepts are different entities

but closely related. There is a fine line between data, information, and knowledge. According to Kakabadse, Kakabadse and Kouzim, the chain of knowledge flow is data, information, realisation, action/reflection, and wisdom (Figure 2.2) (Kakabadse *et al.*, 2003:76).

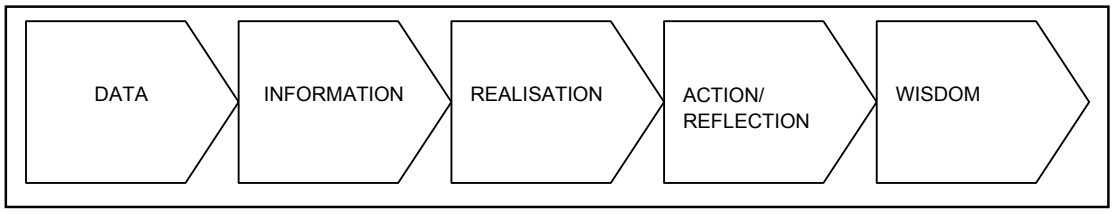


Figure 2.2 The Chain of Knowledge Flow

There are a variety of disciplines that have influenced and informed the field of KM thinking and practice: philosophy - in defining knowledge; cognitive science - in understanding knowledge workers; social science – in understanding motivation, people, interactions, culture, environment; management science - optimising operations and integrating them within the enterprise; information science - building knowledge-related capabilities; knowledge engineering – eliciting and codifying knowledge; artificial intelligence – automating routine and knowledge intensive work; and economics – determining priorities (Kakabadse *et al.*, 2003:79).

There are as many KM models as there are practitioners and theorists. The five best models that are currently enjoying attention are:

1. A philosophy-based model of KM

   The philosophical model is concerned with the epistemology of knowledge or what constitutes knowledge. Its main concern is how to gather information about social and organisational reality, and it is focused on the objectives, the type, and the source of knowledge. It is also concerned with the relationship between knowledge and other notions such as certainty, belief justification, causation, doubt, and revocability (Kakabadse *et al.*, 2003:80-81).

2. A cognitive model of KM

   The recognition by business and economic disciplines of the economic value of knowledge, continuous efforts to derive benefits from information via information management, and the proliferation of Information Technology (IT) all contribute to the proliferation of the cognitive model of KM (Swan & Newell cited in Kakabadse *et al.*, 2003:82-83).

3. A network model of KM

   The networking perspectives of KM emerge parallel with the theories of the network organisation and focus on acquisition, sharing, and knowledge transfer. Network organisations are considered to be characterised by horizontal patterns of exchange, independent flow of resources, and reciprocal lines of communication (Powell cited in Kakabadse *et al.* 2003:83).The focus is on how patterns of links between individuals and interest groups structure cliques, coalitions, and cleavages and facilitate knowledge sharing and transfer. Thus, networking, or actively building new and maintaining old social relations, with a view to creating a vantage position (Useem cited in Kakabadse *et al.*, 2003:83) in the flow of knowledge exchange and transfer is regarded as being an important activity in its own right.

4. A community of practice model of KM

   As children, we first learn from stories. Knowledge has been traditionally passed from generation to generation in this way. Storytelling is a well-known technique for conveying complicated meaning in a simplified format to handle complex situations. The term “community of practice” (CP) was coined in the context of studies of traditional apprenticeship (Lave & Wenger cited in Kakabadse *et al.*, 2003:84). A CP model is widely distributed and can be found at work, at home, or in recreational activities. The model assumes the sense of joint enterprise that brings members together, relationships of mutual engagement that bind members together into a social entity, and the shared collection of communal resources that members have developed over time through mutual engagement (Wagner cited in Kakabadse *et al.*, 2003:84). The

CP model also relates to the current shift in knowledge production and knowledge use, namely a move away from representational modes of knowledge to modes of knowledge operative within user communities – how communities produce and use knowledge. This emphasis focuses on the processes rendering knowledge movable in communities – what makes knowledge transferable. The packaging of knowledge or the commodification of knowledge in user communities has become the key issue alongside the transportability of knowledge.

5. A quantum model of KM

   The quantum model assumes that current information and communication technology will fundamentally change when built by using quantum principles. It is knowledge that is not driven by facts, but by scenario's, hence one that is not achieved as a result of deep rational analysis but, also, through intuition, emotions, and empathy. Meaningful knowledge is needed that makes it possible to decide, effectively, to make a successful whole from complex, inter-related, dynamically-changing and sometimes even conflicting parts. It allows multiple-reality decision making in business situations where paradoxes prevail and human-level decision making falls short (Tissen *et al.* cited in Kakabadse *et al.*, 2003:84-85).

All five models will play a role (to some extend) in the organisation involved with IK, KM, and IT, but specifically, the first four models, philosophy-based, cognitive, network, and community based models will be explored. The Network KM model and the Philosophical KM model will both be involved in knowledge generation, i.e. the IK side of the endeavour. The Cognitive KM Model and the Community KM model will be involved in knowledge application, i.e. the KM and IT side of the scale. Another facet is that both the Philosophical KM model and the Community KM Model are interactive and reliant on people whereas the Network KM model and the Cognitive KM model is integrative and more reliant on IT (Kakabadse, 2003:85-86). Barabas (cited in Kakabadse *et al.*, 2003:79) says that "there is no universal foundation for knowledge, only the agreement and consensus of the community".

The models needed for the IK team, consisting of the indigenous people and those responsible for gathering the IK, can now be identified. The gathering the IK will from now on be called the organisation.

2.5. FIVE GUIDELINES FOR DEVELOPING AND/OR IMPLEMENTING A FRAMEWORK

The five guidelines for developing and/or implementing a framework as suggested by Wong & Aspinwall (2004:100) are:

- Incorporate a clear structure within the framework to enable the construction and organisation of the to-be-identified KM tasks.
- Address the different knowledge resources or types of knowledge to be managed.
- Include the KM processes that will be needed to manipulate the knowledge.
- Identify and include significant influences that will affect the performance of KM efforts.
- Provide balanced and integrated technological, cultural, and social behavioural perspectives.

In section 2.6, these guidelines will be discussed in more detail. The guidelines are discussed by Wong and Aspinwall in their article reviewing the existing KM frameworks.

Guideline 1: *Incorporate a clear structure within the framework to enable the construction and organisation of the to-be-identified KM tasks.*

- A structure determines how individuals interrelate both officially and unofficially.
- A structure determines how individuals are organised, horizontally and vertically.
- A structure determines how tasks and responsibilities are divided.

- The framework should implement a structure that can clearly organise and characterise the type of activities to be performed (Wong & Aspinwall, 2004:101).

There is no commonly accepted way to structure a framework, thus a well-defined concept such as the Plan-Do-Check-Act cycle (Dale & Cooper cited in Wong & Aspinwall, 2004:101) is advised by the authors of this article.

Guideline 2: *Address the different knowledge resources or types of knowledge to be managed.*

- The types of knowledge can be divided into two categories: tacit and explicit knowledge.
- A distinction between the two should be highlighted clearly because they have to be treated differently and catered for differently. They are at different ends of the knowledge spectrum with dissimilar characteristics.
- Explicit knowledge is formal and is often articulated, expressed, presented, codified, and documented. Explicit knowledge is easy to store and distribute throughout the organisation.
- Tacit knowledge, on the other hand, is personal, deeply rooted in an individual's mind, and embedded in an individual's experience, action, behaviour, and values. Tacit knowledge is hard to express and codify because it is part of an individual and recording or retrieving such knowledge is a lengthy process.
- An inventory of people's knowledgeable areas is one way of organising tacit knowledge, whereas a computerised knowledge map would be more relevant for explicit knowledge. Likewise, face-to-face conversations, group meetings, and practice forums are better for transferring tacit knowledge whereas shared databases of lessons learned, groupware, and electronic data interchanges are more appropriate for explicit knowledge (Wong & Aspinwall, 2004:101).

Guideline 3: *Include the KM processes that will be needed to manipulate the knowledge.*

- KM processes are fundamental functions that an organisation performs in processing, and they are activities that an organisation performs in manipulating its knowledge resources (Holsapple *et al.* cited in Wong & Aspinwall, 2004:101).
- KM activities and KM tasks are theoretically the same thing. They highlight for practitioners the major activities that should be undertaken to operate with their knowledge resources.
- Examples of KM processes include, but are not limited to, the following: creating, acquiring, capturing, organising, storing, accessing, transferring, sharing, distributing, applying, and using knowledge.
- The framework should give a clear guideline as to which of these processes are necessary (Wong & Aspinwall, 2004:101).

Guideline 4: *Identify and include significant influences that will affect the performance of KM efforts.*

- Managers/facilitators should be aware of both the inhibitors that will obstruct the progress and enablers that will facilitate the effort in addressing KM. Being aware of these two facets and understanding the influences are crucial in the organisation's efforts.
- The types of influences that will affect performance have been researched in detail in KM literature. Organisational culture has been advocated by researchers as a crucial factor that will determine the success or failure of a KM initiative. This is also true for IK. Culture in any form plays a major role. A few of the researchers who advocate this perspective are - Beckman, 1999; Jarrar, 2002; Apostolou and Mentzas, 1998; Liebowitz, 1999 cited in Wong & Aspinwall, 2009:102. The reason for this is that organisational culture has extensive implications on how knowledge is created, shared, and distributed.
- A culture that emphasises knowledge hoarding; discredits trust, cooperation, and collaboration; undermines learning and knowledge seeking; and

encourages the punishment of mistakes can find it difficult to create and share knowledge (Wong & Aspinwall, 2004:102).

Guideline 5: *Provide balanced and integrated technological, cultural, social, and behavioural perspectives.*

- The issue of balance between a technological and a social approach to KM is of acute importance because, if the issue is not properly addressed, there may be a tendency by practitioners to take an overly narrow approach towards implementing KM.
- An exclusive inclination towards either a purely technological or purely social view may lead to an incomplete picture of what is needed for a successful KM effort.
- IT is a good repository for storing knowledge and an effective channel for transferring knowledge that goes beyond the boundaries of space and time, but it is not KM.
- In contrast, humans alone are inadequate to promote good KM practice because they are slow in converting, manipulating, and transferring knowledge.
- KM should be viewed as a system that comprises a technological subsystem as well as a social one.
- To enable KM, both hard tools and soft skills need to be created and nurtured (Gao *et al.*, 2002; Offsey, 1997 cited in Wong & Aspinwall, 2004:102).

The guidelines presented by the authors can be used to guide the choice in framework as well as the implementation thereof. Although these guidelines can direct the process, the recognition of the high value of experiential knowledge has led to a new awareness about the need to reassess how human resources are managed and the need to revisit the cultural content of knowledge (Mchombu, 2007:26). Joseph Stilglitz (cited in Mchombu, 2007:26) emphasizes the need for giving employees/citizens incentives to develop their own capacities and to have confidence in using their own intelligence to empower change and learning activities. Therefore although the above can be used for guiding the process, each of the users/community

members/task team members, etc. (the IK team) should be included in the process of deciding on the guidelines to be implemented, and their ideas should be taken into account because they are the ones responsible for the workings or failings of the implemented system.

2.6. EXISTING KM FRAMEWORKS

One reason why so many organisations are still struggling with KM and failing in their endeavours to realise its full potential is that the support of a strong theoretical foundation to guide its implementation is lacking (Wong & Aspinwall, 2004:102). If knowledge is viewed as a resource that is critical to an organisation's survival and success, then like any other resource it demands good management (Holsapple & Joshi, 2002:47). Therefore, the focus in this section is to analyse existing KM frameworks in order to identify whether one of these KM frameworks is suitable to help guide the process of managing knowledge within an IK driven organisation once it starts work on a project.

A review of existing KM frameworks has to take place with the guidelines (as discussed in section 2.5) put to the chosen framework, if any framework is in fact chosen. Rubenstein-Montano, Liebowitz, Bulchwalter, McCaw, Newman, Rebeck, stated that KM frameworks are characterised by their role as overseer or provider of guidance for the discipline (Rubenstein-Montano *et al.* cited in Wong *& Aspinwall*, 2004:94). The goal is to determine the best framework for KM and IK while keeping South African communities in mind.

The next step is to determine what a KM framework is and what its purpose is. A good definition of a KM framework is provided by Weber, Wunram, Kemp, Pudlatz, Bredenhorst: "A KM framework explains the world of KM by naming the major KM elements, their relationships and the principles of how these elements interact. It provides the reference for decisions about the implementation and application of KM" (Weber *et al.*, 2002:5). The inclusion of existing frameworks in this study is of key importance. It will have to be determined whether an existing framework can work for

the field of IK, whether two or more frameworks have to be integrated, or whether a new framework needs to be created for this specialised field. The reason for constructing a KM framework is that, once the IK database has been created, its users will need a way to manage the knowledge in an objective and well-controlled way. The very nature of the field warrants such an inclusion to ensure that future users will receive the correct knowledge. Therefore these guidelines in the form of a KM framework will have to be made available to them. In order to accomplish KM, a structure, a set of principles, or a framework is needed to underpin and provide a theoretical basis for performing the relevant actions and activities (Wong & Aspinwall, 2004:94).

In addition to many different KM frameworks, there are also many different types of frameworks. These frameworks focus on different aspects of KM. Wong *et al.* discuss these different types of frameworks:

1. Nonaka and Takeuchi (1995 cited in Wong & Aspinwall, 2004:94) developed a knowledge-creation framework. This framework focuses on how the evolution and conversion between explicit and tacit knowledge can lead to a knowledge creation spiral.
2. The second type of framework characterises and describes the knowledge cycle processes of KM. It mainly addresses the phases of knowledge flow, without providing guidance on how to implement KM.
3. The third type of framework includes an approach that have been developed by researchers to serve as a basis for examining how KM has been performed in industry. These frameworks provide a reference to facilitate the structuring, analysis, and evaluation of the KM initiatives.
4. The fourth and final type of framework provides more detailed directions on the implementation of KM. This type of framework seems to address not only the question pertaining to “what is” but also “how to” because it prescribes and suggests ways for organisations to engage in KM activities (Wong & Aspinwall, 2004:94-95).

The next step is to describe some of the existing KM frameworks that are considered to be some of the leading KM frameworks and to determine whether one/more of them will be appropriate for the IK field. Two articles have been chosen, Holsapple & Joshi (1999) and Wong & Aspinwall (2004), that present and compare existing KM frameworks in the form of a schematic exposition on the following levels respectively;

- broad frameworks, specialised frameworks; and
- systems approach frameworks (describe and characterise KM in the form of a graphical representation with the aim of providing a systemic and holistic perspective); step approach frameworks (provide a series of steps or procedures to be followed), and hybrid approach frameworks (contains elements of both these approaches); the schematic exposition of the existing frameworks is included in Addendum 2.

Throughout the search for a KM framework, it was kept in mind that it is important that the framework must allow for an organisational culture to be created and nurtured. From the above schematic of existing frameworks, only one of the frameworks could be identified as a good candidate, i.e. the 'threefold framework' by Holsapple and Joshi, as discussed by Wong and Aspinwall in Table 5 (Addendum 2). The KM phenomena depends on characterising knowledge resources that need to be managed, identifying and explaining activities involved in manipulating these knowledge resources, and recognising factors that influence the conduct of KM (Holsapple & Joshi, 2002:48). The threefold framework consists, as the name suggests, of three components. The following diagram (Figure 2.3) is an illustrational representation of the framework.

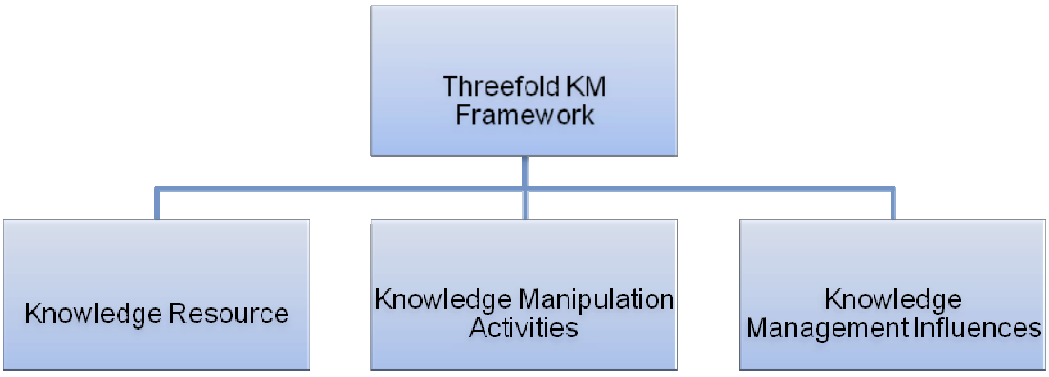


Figure 2.3 Threefold KM

2.6.1 First Component: Knowledge Resource

The first component provides a taxonomy that identifies the kinds of knowledge resources that an organisation can have and manage. A conventional organisation consists of three main types of resources: material, human, and monetary resources (Miner cited in Holsapple & Joshi, 2002:51). Knowledge can be stored, embedded, or represented in an organisation as any of six distinct kinds of resources: participants' knowledge, culture, infrastructure, knowledge artefacts, purpose, and strategy. Apart from the six types of knowledge resources within its boundaries, an organisation has access to knowledge existing in its environment. Although it does not belong to an organisation, it is a crucial source for replenishing and augmenting an organisation's knowledge resources. Both researchers and practitioners must be cognisant of the relationships between environmental knowledge resources and the six types of organisational resources (Holsapple & Joshi, 2002:52), which are:

1. Participants' knowledge – The knowledge that a participant brings to bear in the execution of its role within an organisation is a knowledge resource of that organisation. Being the combination of such knowledge, an organisation's participant knowledge resource is thus affected by the arrival and departure of participants, participant learning, the portion of each participant's knowledge

that is brought to bear on organisational work, and the interrelationships that participants' knowledge are allowed to have (Holsapple & Joshi, 2002:52).

2. Culture – Culture is defined by Schein as the "basic assumptions and beliefs that are shared by members of an organisation, that operate unconsciously, and that define in a basic taken-for-granted fashion an organisation's view of it self and its environment." An organisation's values, principles, norms, and unwritten rules and procedures comprise its cultural knowledge resource (Holsapple & Joshi, 2002:53).
3. Infrastructure – Infrastructure refers to "the roles that have been defined for participants to fill, the relationships among those roles, and regulations that govern the use of roles and relationships". The infrastructure knowledge resource governs not only ordinary organisational operations, but also the designing, enabling, monitoring, evaluating, enforcing, and modifying of organisational infrastructure (Holsapple & Luo cited in Holsapple & Joshi, 2002:53).
4. Knowledge artefacts – A knowledge artefact is an object that represents knowledge. Common examples of knowledge artefacts are video training tapes/DVD's, books, memos, business plans in print, manuals, patent documents, filing cabinet contents, and products. An example of an IK artefact in South Africa can be Zulu dances, clay pottery of various tribes, etc.
5. Purpose – Purpose is knowledge about the reason why an organisation exists. It is a knowledge resource that indicates an organisation's mission, vision, objectives, and goals. It strongly influences the other knowledge resources that an organisation does or needs to have.
6. Strategy – Strategy is knowledge about what to do in order to achieve the organisational purpose in an effective manner. This knowledge resource indicates plans for using an organisation's infrastructure, culture, knowledge artefacts, and participants' knowledge (Holsapple & Joshi, 2002:54).

2.6.2. Second component: Knowledge Manipulation Activities

The second component identifies basic types of activities that can be used to manipulate an organisation's knowledge resources. An organisation's participants

(human and computer-based) use their knowledge-handling skills to execute these manipulation activities, producing and consuming knowledge flow in the process. The framework has four knowledge manipulation activities and they are:

1. Acquiring knowledge – Acquiring knowledge is the activity of accepting a unit of knowledge from the external environment and transforming it into a representation that can be internalized. Sub-activities in acquiring knowledge are: extracting knowledge from external sources, interpreting the extracted knowledge, and transferring the interpreted knowledge.
2. Selecting knowledge – Selecting knowledge is an activity of extracting a requested unit of knowledge from internal knowledge resources and providing it in an appropriate representation to a requesting activity. Sub-activities are: locating requested knowledge within the internal knowledge resources, retrieving the located knowledge, and transferring retrieved knowledge to an appropriate activity.
3. Internalising knowledge – Internalising is an activity that alters an organisation's knowledge resources based on acquired or generated knowledge. Sub-activities are: assessing the knowledge to be internalised, targeting the assessed knowledge, and depositing the knowledge targeted.
4. Using knowledge – This refers to the activities of externalising knowledge and generating knowledge (Holsapple & Joshi, 2002:56-57).

2.6.3. Third Component: Knowledge Management Influences

The third and final component characterises three classes of factors that shape the conduct of KM in an organisation. These classes of factors are: resource influences, managerial influences, and environmental influences.

1. Resource influences – Both knowledge resources and other resources affect the way in which KM is conducted in an organisation. Financial resources could put a ceiling on the capital expended on knowledge-manipulation activities. Each of the six types of knowledge resources influences the conduct of KM in an organisation.
2. Managerial influences - The conduct of KM is affected not only by the existence of various resources, but also by the deployment of these resources.

Managerial influences can govern the state of an organisation's knowledge resources and the use of knowledge manipulation skills in performing the activities (stated above).

3. Environmental influences - Apart from internal factors, entities outside an organisation also affect its treatment of KM. The environment determines or constrains what knowledge resources should or can be acquired, as well as what knowledge manipulation skills are available (Holsapple & Joshi, 2002:58-60).

It is clear from these components that the KM framework assumed relates to more sophisticated companies or organizations. KM frameworks that would operate or be devised to include communities as users are something quite different and a major challenge, if ever possible. Hosapple & Joshi (2002) conducted a survey to determine the completeness, accuracy, clarity, and conciseness of frameworks. Addendum 1 shows the results of the survey.

The authors or rather engineers of the framework, Holsapple and Joshi, states that "In its current stage of development, the framework has several uses. It provides a language (i.e., a system of terms and concepts) for discourse about and study of KM phenomena" (Holsapple & Joshi, 2002:61).

Finally, the question is: Does this KM framework comply with the five guidelines as discussed in section 2.5? To illustrate the compliance or non-compliance, a table (Table 2.1) has been created. The indicators for adherence to the framework implementation or not is represented as follows:

C – Compliant: Yes, the framework does comply with the guideline, 100%.

A/C – Almost Compliant: Yes, the framework does comply, but some improvements should be made for a 100% compliance.

N/C – Not Compliant: There are areas that should receive attention before implementing the framework.

Compliance/Non-Compliance of the KM Framework with Guidelines				
	Guideline	**Indicator**	**Compliance (if applicable)**	**Area for improvement**
1.	Incorporate clear structure within the framework to enable construction and organisation of the to-be-identified KM tasks.	A/C	First component of KM framework: Knowledge Resource.	The guideline must be further adhered to by incorporating a clear IK component.
2.	Address the different knowledge resources or types of knowledge to be managed.	A/C	Second component of KM framework: Knowledge Manipulation Activities.	This guideline stipulates clearly that an unambiguous guide for working with tacit/explicit knowledge have to be in place within the organisation.
3.	Include the KM processes that will be needed to manipulate the knowledge.	A/C	Second component of KM framework: Knowledge Manipulation Activities.	The component is discussed in broad terms and every organisation will have to adapt the item to fit their organisation's needs.
4.	Identify and include significant influences that will affect the performance of KM efforts.	A/C	First component of KM framework: Knowledge resource.	
5.	Provide a balanced and integrated technological and cultural behavioural perspective.	A/C	Third component of KM framework: Knowledge Management Influence.	The third component does address some of the 5th guideline's criteria but should be elaborated on extensively, specifically relating to the role of IT within the KM framework.

Table 2.1 Compliance of the KM Framework with guidelines

The schematic representation in Table 2.1 reveals that there is room for improvement before implementing the threefold KM framework, but it also shows that many of the guidelines' criteria is adhered too in this framework.

In his article *Where did knowledge come from?* Lawrence Prusak states that "…the conceptual rigor of economics, the observational richness of sociology, and the understandings of philosophy and psychology give knowledge management the intellectual scope and substance it needs to wrestle with the real human and structural complexities of knowledge…" (Prusak, 2001:4). According to Prusak, the three practices that have brought the most content and energy to KM are information management, quality management, and human factors/capital movement. In section 2.7 these three practices are discussed in more detail.

2.7. THREE PRACTICES

2.7.1. Information Management

Information management (IM) was developed during the 1970s and 1980s and is usually understood as a subset of the larger IT and information science world. IM is a body of thought and cases that focus on how information itself is managed, independent of technologies that house and manipulate it. It deals with information issues in terms of assessment, operational techniques, governance, and incentive schemes (Prusak, 2001:4). In the context of this thesis, information is best described by Karl Sveiby when he says "when we speak or write, we use language to articulate some of our tacit knowledge in an attempt to pass it on to others" (Sveiby, 1997:40). Throughout the readings on the subject of IM, it was made clear that the terms information management and knowledge management or even information and knowledge are used interchangeably by some, which is incorrect. Information is described by Sveiby as "facts and the communication of facts" (Sveiby, 1997:40). Information is said to be numbers, symbols, pictures, or words displayed on a screen and knowledge is what information becomes when it is interpreted. In broad terms, KM shares information management's user perspective, a focus on value as a function of user satisfaction rather than the efficiency of the technology that houses and delivers the information (Prusak, 2001:4).

Five activities that underpin the creation, flow, and use of knowledge are:

- identifying and acquiring internal sources;

- structuring internal sources;
- sourcing, acquiring, and evaluating external sources;
- integrating internal and external sources; and
- enabling the timely delivery of relevant, usable information (Abell & Oxbrow, 2001:160).

A knowledge environment needs to identify its information resources and map where they are, how they are created and used, which are mission critical and how these are protected (Abell & Oxbrow, 2001:152). IM discovered that not all information is created equal, that different types of information have different values and need to be handled differently (Prusak, 2001:4).

2.7.2. Quality Management

The quality movement focused significantly on internal customers, overt processes, and shared, transparent goals. Quality techniques where applied most successfully to manufacturing processes, while KM has a broader scope, including processes that do not seem to lend themselves readily to measurement or even clear definition (Prusak, 2001:4).

In the late 1980's, when it became apparent that the field of quality management (QM) had keen followers and that it was becoming part of every organisation, professional bodies and industry networks were established. Some of these bodies are the British Quality Foundation, the European Foundation for Quality Management (EFQM), and the American Quality and Productivity Federation (AQFM). According to the website of the South Africa National Accreditation Systems (SANAS), there are currently fourteen accredited bodies and laboratories working in the field of QM within South Africa. The EFQM established a model called the EFQM Excellence Model, which reflects the belief that QM should be for the management of the organisation not an activity undertaken by a few people responsible for quality (Abell & Oxbrow, 2001:22-23). The following concepts underpinning the model were taken from the EQFM website in January 2000 by Abell & Oxbrow. These concepts also reflect what would be expected from QM when working with IK.

- Excellence is dependent upon balancing and satisfying the needs of all relevant stakeholders.
- The customers are the final arbiters of product, and service quality and customer loyalty, retention and market share gain are best optimised through a clear focus on the needs of current and potential customers.
- The behaviour of an organisation's leaders creates a clarity and unity of purpose within the organisation and an environment in which the organisation and its people can excel.
- Organisations perform more effectively when all interrelated activities are understood and systematically managed, and decisions concerning current operations and planned improvements are made using information that includes stakeholder perceptions.
- The full potential of an organisation's people is best released through shared values and a culture of trust and empowerment, which encourages the involvement of everyone.
- Organisational performance is maximised when it is based on the management and sharing of knowledge within a culture of continuous learning, innovation, and improvement.
- An organisation works more effectively when it has mutually beneficial relationships, built on trust, sharing of knowledge, and integration with its partners.
- The long-term interests of the organisation and its people are best served by adopting an ethical approach and exceeding the expectations and regulations of the community at large (Abell & Oxbrow, 2001:23-24).

The reason for QM within the field of KM is to ensure that the quality of the knowledge is upheld. We cannot in good conscious accumulate knowledge or information but not ensure the quality thereof, especially in a field like IK with a strong cultural aspect. The identities of societies are not a place for trial and error approaches. The community needs to be assured that the researchers, instruments being used and all other aspects are of the best quality and that the people involved are upholding the highest standards possible.

2.7.3. Human factors/capital movement

The value of human capital and its importance tend to get distorted or diluted although it has a strong theoretical base. The message that is given by investigators of human capital is that there is an advantage to investing in individuals, mainly through education and training. This kind of investment has a higher return rate in the form of higher productivity, skills development, innovative capacity, and ease of labour mobility than many other options. By definition, human capital focuses on the individual, whereas most knowledge management work is concerned with groups, communities, and networks. Nevertheless, KM builds on human capital ideas and has to continue making the value of human capital clear to leaders (Prusak, 2001:5). In IK, nothing is worth more or more important than the human factor. Human capital consists of four main components: experience, know-how, skills, and creativity (Mertins, Heisig & Vorbeck, 2003:159). The entire concept rests on the knowledge by the participants that the goal is not retrieving and using their knowledge but rather hoarding it for future community members. In doing so, the power will be in the hands of community members allowing them to expand their horizons and to provide their knowledge for the future generations.

2.8. OTHER FACTORS

2.8.1. Two Countries with successful IK databases

In this section, the aim is to review two countries that is successful in preserving IK or made headway in the field. The goal of the organisations involved in these countries is to protect IK and also create awareness of its possible usage. India and the Netherlands are two of the top countries when it comes to the field of IK. They have both succeeded in waging a war against the misconceptions of IK and have made other people and organisations aware of IK and its uses or non-uses as the case may be.

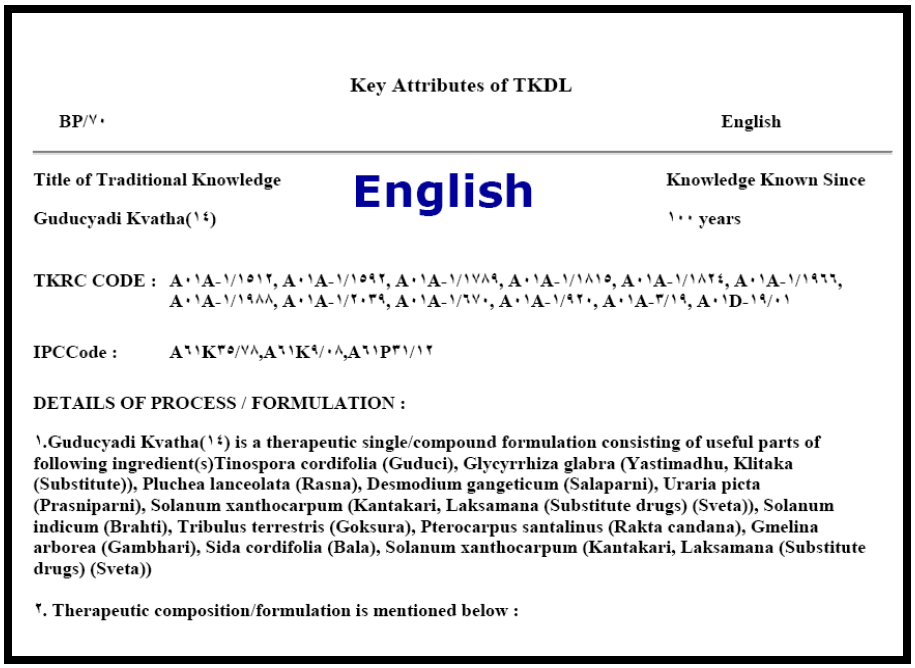
a. India

India has made significant strides in capturing and preserving their IK. They are considered as one of the countries that have made the most progress in

this regard, making them a good benchmark for the rest of the world. The main project is a digital archive of IK, masterminded by the Council for Scientific and Industrial Research (CSIR) of India, and called Traditional Knowledge Digital Libraries (TKDL). The aim of the project is to create a composite digital library comprising of individual IK (SciDev.Net, 2005).

The TKDL is accessible using the internet. TKDL contains information on traditional medicine, foodstuffs, architecture, and culture. The Indian library contains information on 36,000 formulations used in Ayurveda, India's 5,000-year-old system of traditional medicine. The information offered in English, French, German, Spanish, and Japanese was created in a format accessible by international patent offices to prevent the granting of inappropriate patents (SciDev.Net, 2005).

The database set international standards for registries of IK, which were adopted by the intergovernmental committee of the World Intellectual Property Organization (WIPO) in 2003. India's National Institute of Science Communication and Information Resources (NISCAIR) found that, in 2000, almost 80 per cent of the 4,896 references to individual plant-based medicinal patents in the US Patents Office related to seven medicinal plants of Indian origin. In 2003, there were almost 15,000 patents on such medicines in the registries of US, European, and UK patent offices. However, according to the institute's director, Virender Kumar Gupta, none of the 131 academic journals used by patent examiners when deciding whether to grant a patent is from developing countries such as Brazil, China, or India. A project undertaken by India in 2001 entailed the development of a system for classifying resources used in IK that is similar to that used by the International Patent Classification (IPC), called the Traditional Knowledge Resource Classification (TKRC). The IPC has agreed to include the Indian system in its own classification. It will include or already includes about 200 sub-groups of drugs derived from Indian medicinal plants (SciDev.Net, 2005). Figure 2.4 is an example of the TKDL attribute page.



Key Attributes of TKDL

BP/٧٠ English

Title of Traditional Knowledge

Guducyadi Kvatha(١٤)

English

Knowledge Known Since

١٠٠ years

TKRC CODE : A٠١A-١/١٥١٢, A٠١A-١/١٥٩٢, A٠١A-١/١٧٨٩, A٠١A-١/١٨١٥, A٠١A-١/١٨٢٤, A٠١A-١/١٩٦٦, A٠١A-١/١٩٨٨, A٠١A-١/٢٠٣٩, A٠١A-١/٦٧٠, A٠١A-١/٩٢٠, A٠١A-٣/١٩, A٠١D-١٩/٠١

IPCCode : A٦١K٣٥/٧٨,A٦١K٩/٠٨,A٦١P٣١/١٢

DETAILS OF PROCESS / FORMULATION :

١.Guducyadi Kvatha(١٤) is a therapeutic single/compound formulation consisting of useful parts of following ingredient(s)Tinospora cordifolia (Guduci), Glycyrrhiza glabra (Yastimadhu, Klitaka (Substitute)), Pluchea lanceolata (Rasna), Desmodium gangeticum (Salaparni), Uraria picta (Prasniparni), Solanum xanthocarpum (Kantakari, Laksamana (Substitute drugs) (Sveta)), Solanum indicum (Brahti), Tribulus terrestris (Goksura), Pterocarpus santalinus (Rakta candana), Gmelina arborea (Gambhari), Sida cordifolia (Bala), Solanum xanthocarpum (Kantakari, Laksamana (Substitute drugs) (Sveta))

٢. Therapeutic composition/formulation is mentioned below :

Figure 2.4 An example page of the key attributes of TKDL (Meshelkar, 2007:28)

The TKDL consists of 140,000 pages of information on the following:

- IK resource classification for 2,147 plants;
- 350,000 Ayurvedic Yogas/Slokas from 35 identified books; and
- meta-data on how the new methodologies have evolved (Meshelkar, 2007:25).

The TKDL is the first of its kind in the world and is constantly being used as a benchmark by other countries, e.g. South Africa.

b. The Netherlands

The Netherlands has also made important strides in the field of IK. Unlike India, the Netherlands have more than one project. The two main role-players in the field of IK for the Netherlands are INDAKS and NUFFIC-CIRAN.

The INDAKS project worked in the field of agriculture. The project situated at Leiden focuses its attention on the intellectual and material components of the local setting such as concepts, perceptions, beliefs, cosmologies, attitudes,

practices, experiences, skills, technologies, artefacts, seeds, plants, crops, institutions, procedures and processes used by a particular group, community, or society in relation to agricultural food production, and natural resources management (Slikkerveer, 1997:18).

Another organisation in the Netherlands that made an impact in the field is the Centre for International Research and Advisory Networks (CIRAN), which is a department of the Netherlands Organisation for International Cooperation in Higher Education (NUFFIC). One contribution that they made is the publication of the Indigenous Knowledge and Development Monitor (IK&DM) since 1993. The publication appears three times a year and is distributed free of charge to readers in developing countries (Von Liebenstein & Van Marrewijk, 2000:1-21). The aim of the organisation is to build up an IK information System as a way to help generate "knowledge for development". The system at present has the following components:

- IK notes: pages offering links to relevant information on IK;
- IK resources: offering direct information in the form of notices, reports, and articles;
- IK&DM online: offering all issues of the journal in complete form;
- news and announcements dealing with IKS and practices;
- mailing lists to facilitate discussion and exchanges of information on specific topics such as biodiversity and animal production and healthcare;
- best practices on IK: a database maintained in cooperation with UNESCO as part of its MOST programme; and
- a worldwide database containing information on IK experts in various policy sectors and disciplines (Von Liebenstein & Van Marrewijk, 2000:2).

NUFFIC has removed all the IK information from their current (March 2008) website. Whether this is a temporary or permanent move is unknown at present. Nevertheless, their contribution to IK cannot be ignored. They were

also involved in numerous IK projects across the African continent. It seems that some of the information now resides on the World Bank website, IK notes, and also an IK Practices database. Whether these two are related in any way is unclear, but these organisations have worked together on some projects in years gone by.

These two countries can be seen as good examples of how to promote the responsible usage of IK. The goal of the organisations involved was and is to preserve IK. A look at the work they have done thus far shows that South Africa still has a long struggle ahead.

2.8.2. The stance of leading role players in field

Internationally, there are a few organisations that can be seen as leading role players in the field. The impact they have made and are making in the field is remarkable. The aim of this section is briefly to discuss some of these organisations and to look at the work that they have done.

The World Bank is one of the organisations who have thus far committed themselves in the field of IK. The World Bank's goals for IK (as explained under IK for development) is to "raise awareness among the development community of the role that community-based practices can play in enriching the development process, to help development practitioners to mainstream IK into the activities of development partners, and to optimize the benefits of development assistance, especially to the poor" (World Bank 1(a), 2008).

These goals, which are being realised through some key strategies, are:

a. a database on IK and practices with nearly 300 entries (see Figure 2.5 for and screenshot example of the database);
b. a series of monthly "IK Notes" which present in some detail locally driven solutions to often complex issues;
c. cross regional, peer-to-peer learning exchanges aimed at enhancing local capacity for identifying and applying IK and practices;

d. mainstreaming the application of IK in World Bank supported projects and in national development programs; and
e. brokering collaboration on IK issues between local practitioners, community-based organizations, governments, donors, and the global scientific community as well as other international organizations (World Bank 1(a), 2008).

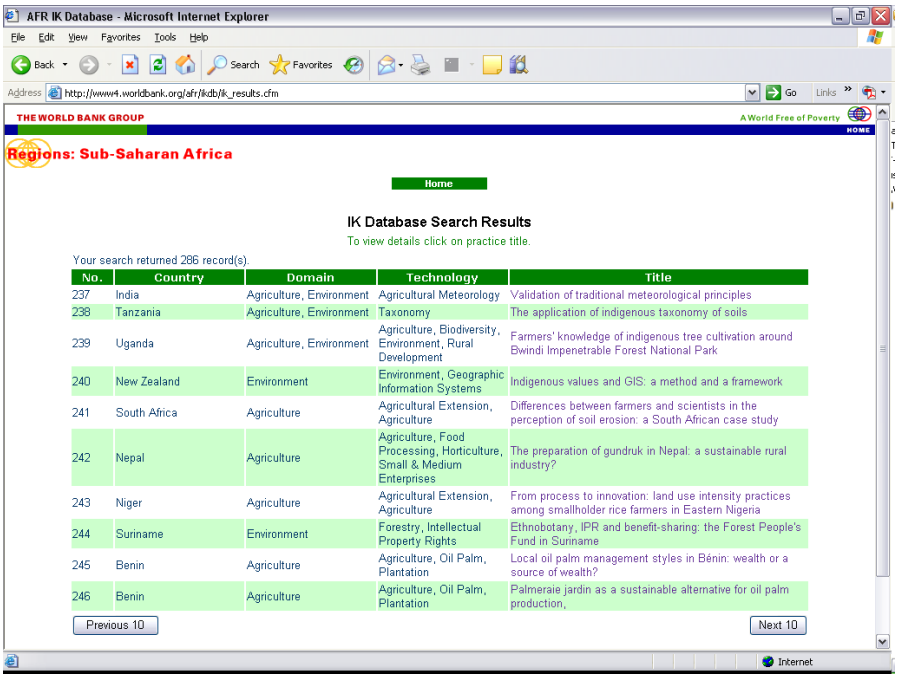


Figure 2.5 Example of the World Bank IK database (World Bank 1(e), 2008)

Areas where the bank has made significant strides in IK is; integrating IK in Bank supported projects, mainstreaming IK in development, enhancing capacity through peer-to-peer exchanges, collection and dissemination of IK and Building Partnerships (World Bank 1(b), 2008).

Another international organisation that has done some good work is the United Nations Educational, Scientific and Cultural Organization (UNESCO). UNESCO was founded in November 1945 as a specialized United Nations agency. The purpose of the organization is to be a laboratory of ideas and a standard-setter to forge universal agreements on emerging ethical issues. UNESCO also serves as a clearinghouse for the dissemination and sharing of information and knowledge, while helping member

states build their human and institutional capacities in diverse fields (UNESCO 2(a), 2007).

In the field of IK or “culture” (as UNESCO entitles it), some strategic priorities are: promoting the drafting and implementation of standard-setting instruments in the cultural field, safeguarding cultural diversity and encouraging dialogue among cultures and civilizations, and enhancing the links between culture and development through capacity-building and sharing knowledge (UNESCO 2(b), 2005). Some projects in which UNESCO is involved or to which it contributes/contributed are:

- Ethnobotany and the People and Plants Initiative;
- Local and Indigenous Knowledge Systems in a Global Society (LINKS);
- Traditional Water Harvesting: Regional Seminars in Iran; and
- The Universal Declaration on Cultural Diversity (UNESCO 2(c), 2002).

The last international organisation that deserves mention is the International Union for Conservation of Nature (IUCN). IUCN helps develop conservation science, manages field projects all over the world, and brings together players from different domains and sectors to develop and implement policy, laws, and best practice. This work encompasses all types of animal and plant species on the planet, all types of ecosystems, the different types of natural places that exist on earth, and a wide range of major environmental and sustainable development issues (IUCN, 2008). Although they are not expressly involved in IK as such, their work as a conservation organisation and specifically their sustainable development projects directly impact on the communities which, in turn, impacts on the field of IK.

In South Africa, there is only one organisation likely to be cited and that is the Medical Research Council (MRC). There are many organisations that are also starting or have already made some inroads in the field, but the MRC have established a functional (not only on paper) IKS programme. The programme is up and running, and therefore, they are chosen as a leading role player for South Africa. One of their aims

is to validate the traditional medicines using sound scientific methods acceptable to international standards (MRC, 2008). The information on the databases that is made available to the public are considered as communal information. No information that is not communal will be open to the public. They are currently developing the following databases:

- TRAMED III (traditional medicines and medicinal plants), a database of monographs. (developing a South African pharmacopoeia) [Figure 2.6, note that apart from the first web page no information was available];
- Monographs (SATMERG is a joint research group with the School of Pharmacy of the University of the Western Cape (UWC): The idea is to develop a South African Pharmacopoeia) [Figure 2.7];
- Medicinal Plants (The Medicinal Plants Database is a database containing developed methods and procedures for handling claims for cures. A database of all claims presented at the IKS [Health] Lead Programme is documented. The uniqueness of this database is that it represents current medications and traditional practices that are used.) [No online access]; and
- GIS Mapping of Traditional Healers (a GPS mapping of traditional healers in the country) [No online access] (MRC, 2008).

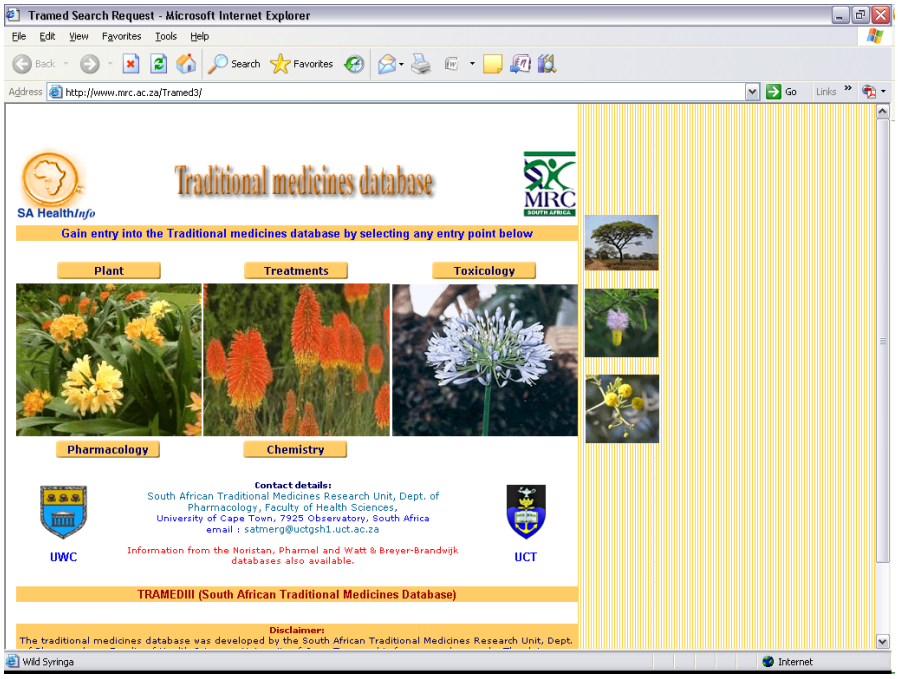


Figure 2.6 Traditional Medicines database (TRAMED III) (MRC, 2008)

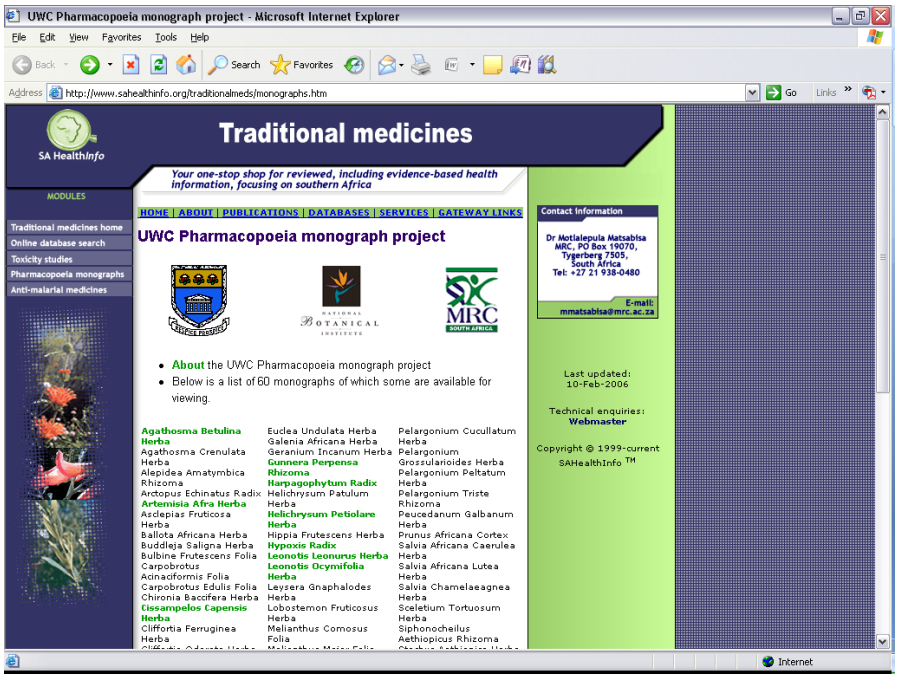


Figure 2.7 UWC Pharmacopoeia monograph project (Monographs) (MRC, 2008)

When looking at starting an IK project these role players can play an immensely important role in determining what can and cannot be done, how to do it, and also to check whether someone has not already started doing it.

2.8.3. Benchmarking

There is a misconception that the purpose of benchmarking is to copy what other people are doing. In fact, benchmarking is the systematic learning process for identifying best practices, winning strategies, and innovative ideas that lead to superior performance. The purpose of benchmarking is to rethink and improve one's own practices (Allee, 1997:205).

A best practice on IK refers to examples and cases that illustrate the use of IK in developing cost-effective and sustainable survival strategies for poverty alleviation and income generation. These include indigenous land-use systems to encourage labour-sharing arrangements among farmers, using IK to increase the fuel-efficiency of local stoves instead of replacing them, and using indigenous institutions by extending credit through existing village loan groups. In gathering this information, the interest lies not in the details of the IK (for example, the technical specifications of the stove), but in the ways that the IK has been adapted, applied, and disseminated (CIRAN, 2003).

The Centre for International Research and Advisory Networks (CIRAN) and the Management of Social Transformation Programme (MOST) of UNESCO have produced a publication and also constructed a Database on 'Best Practices on Indigenous Knowledge' to show how IK can be put to good use in development practice. CIRAN selected twenty-seven best practices in the field of IK for inclusion in the UNESCO-MOST Database. Developments in IKS in South Africa take into account developments in the region, i.e. the South African Development Community (SADC), as well as on the continent (Mosimege, 2005:7). The idea of a best practices database is based on the observation that carefully documented case histories can provide excellent guidelines for policy making and planning new projects. The aim of the database of best practices on IK and sustainable development is to encourage

researchers and policymakers to incorporate IK into their project proposals, feasibility studies, implementation plans, and project assessments. It also helps to take IK and practices into account in all activities affecting local communities. There are many people that are working on projects in which IK plays an essential and practical role. It is very important that information about these kinds of projects is made available worldwide so that other people can learn from the experiences. The best practices database will play a prominent role in building a bridge between empirical solutions, research, and policy (CIRAN, 2003).

A database of best practices, in order to benchmark what the pitfalls and successes are when working with IK, makes a significant contribution in that such a database could help researchers in identifying the possible problem areas and knowing how to side step or rise above them, as well as finding out where to start. A look at research done by other organisations is a must before embarking on one's own project. However, keep in mind that no two communities are the same and though reading up on possible problems and solutions is a good idea, assuming that you will have the same issues is not recommended. Approach each community on the basis of its own individual grounds and needs.

2.8.4. Intellectual property law in South Africa

Grenier (1998) describes Intellectual property rights (IPR) as "mechanisms to protect individual and industrial 'inventions' [that] are usually in effect for a specified period. These legal rights can be attached to information if the information can be applied to making a product that is distinctive and useful. Legal rights prevent others from copying, selling, or importing a product without authorisation." According to Grenier, there are six forms of intellectual property (IP): patents, plant-breeders' rights, copyright, trademarks, industrial design, and trade secrets (Grenier, 1998:13). IPR gives the creator the right to prevent others from making unauthorised use of their property for a limited period of time (Mosimege, 2005:9).

There are some fundamental problems with current South African IP laws that should be resolved. According to Mosimege, these problems are:

a. The current system seeks to privatise ownership and is designed to be held by individuals or corporations, whereas IK has collective ownership.
b. The protection is time-bound, whereas IK is held in perpetuity.
c. It adopts a restricted interpretation of invention, which should satisfy the criteria of novelty and be capable of industrial application, whereas IK innovation is incremental, informal, and occurs over time (Mosimege, 2005:10).

There are ways to work around these problems, as discussed by Correa (2001) cited in Mosimege, 2005:11). A number of examples in which IK or parts thereof may be protected under existing modes of IPRs are:

a. Copyright can be used to protect the artistic manifestations of IK holders, especially artists who belong to indigenous and native communities, against unauthorised reproduction and exploitation.
b. The Patent System could be used for the protection of technical solutions that are industrially applicable and universally novel, and which involve an inventive step.
c. New plant products, cultivars, and varieties of all species of plants may be protected under plant breeders rights (PBRs).
d. The design and shape of utilitarian craft products such as furniture, receptacles, and garments and articles such as ceramics, leather, wood, and other materials may qualify for protection as industrial designs.

Mosimege goes on to state that it is clear that there are conflicting views as to whether IK can be protected by existing IP regimes. It is important that different countries continue to explore various possibilities of protecting IK (Mosimege, 2005:12).

A South-African case of where IK of a specific community was used for financial gain by another organisation is the incident of the Hoodia plant. The San community has traditionally eaten the Hoodia Cactus to stave off hunger and thirst on long hunting trips. Other uses of Hoodia are that Hoodia sap can be used to treat eye infections and the brew of boiled Hoodia pieces can be used to treat severe stomach pain. In

clinical trials on obese subjects, extracts from the Hoodia plant have been shown to reduce caloric intake by 30% to 40%. Significant weight loss has resulted from such a drop in caloric intake. In 1995, the CSIR (after many years of research and interaction with the San community in the Kalahari) patented the Hoodia's appetite-suppressing elements. In 1997, the CSIR licensed to Phytopharm, a UK biotech company. In 1998, the Pharmaceutical Company Pfizer acquired the rights to develop and market P57 as a potential slimming drug. In March 2003, the CSIR signed an agreement with the San Community about benefit sharing and royalties emanating from the patenting and licensing and royalties from Hoodia. There has not been any transfer of payment of benefits to the San Community to date. A process of establishing a trust is in its final stages (Mosimege, 2005:21). One area that has received quite extensive attention is the IPR in India. According to Meshelkar, reasons for protecting IK are: equity considerations, conservation concerns, the preservation of traditional practices and culture, the prevention of appropriation of IK, and the promotion of its use in development (Meshelkar, 2007:11).

It is therefore imperative that South Africa have IP laws in position before any work with the community commences. The communities' IK needs to be protected at all cost. The laws are not in place, but there is one saving grace for researchers or organisations that do not want to wait for government and would like to work with communities. This grace is the World Intellectual Property Organisation (WIPO). The main objective of WIPO is to protect and promote IP and to build capacity in member states to derive economic benefit from their IP. In Africa, The African Regional Intellectual Property Office (ARIPO) caters for former British colonies (IKS Policy, 2004:29). The work of these two organizations can be inspected before starting work with the community/communities. Since the research for this thesis has started, the Department of Trade and Industry has given a general notice on the draft policy and bill named "Policy Framework for the protection of Indigenous Traditional Knowledge through the Intellectual Property system and the Intellectual Property Laws Amendment Bill". The General notice is dated 5 May 2008.

2.8.5. The role that ethics play in IKS

The first question to be asked is 'What is ethics?' Ethics is concerned with moral obligation, character, responsibility, and social justice. To be ethical means to pursue right conduct, to fulfil one's moral obligations and responsibilities, and to seek social justice (Lewis & Speck, 1990:7). The second question is 'Why be ethical?' It is better to be right than wrong, moral than immoral, just than unjust, and it is better to be good than bad. How to determine all these factors is a part of our social education, accepted by most of us without question much in the way that we accept without question that we know what is meant by the words stealing and wrong (Lewis & Speck, 1990:8).

Indigenous communities have previously been exploited by research practices based on exploitation, racism, ethnocentricity, and/or harmful factors (Ermine & Jeffery, 2004:12). As people, civilisation, and organisations have matured, they have become more concerned with ethical conduct (Lewis & Speck, 1990:213), and this is also the case with IK. Researchers in IK have been and are ethically bound to the community. Ethics and IK are not a new principle. People working in the field must be moral and just, without any discrepancy. The indigenous approach may be defined as ethically and culturally appropriate (Porsanger, 2004:109).

The process of theorising and measuring what is considered to be "scientifically acceptable" have been based on Western philosophy and imply a notion of objective research, which was recently questioned by feminists and indigenous researchers who articulate different epistemologies. Cheryl Crazy Bull (1997, cited in Porsganger, 2004:110) states that "the scientific method requires the researcher to remain outside the research experience, to investigate through observation and discovery, and to draw conclusions based on those observations" but, seen from an indigenous viewpoint, such a method does not guarantee objectivity (Porsanger, 2004:100). At first glance, it would appear that culture and ethics are unrelated, but men and woman conduct their interaction, enterprises, and lives according to the values that they have derived from their cultural heritage. Despite the intellectual efforts of many people to create an ethical order in research involving indigenous peoples, for

example by developing ethical guidelines, many of the same critiques remain. Issues such as the appropriation of knowledge and collective versus individual ownership of knowledge remain unclear (Ermine & Jeffery, 2004:16-22).

The proposal is that instead of delving deeper into the field of ethics, which seems to be quite a quandary as well as culture driven (a notoriously difficult field to navigate), attention is focussed on developing a code of conduct. A code of conduct clarifies the standards of behaviour that are expected of the organisation's staff in performing their duties. It gives guidance in areas where staff needs to make personal and ethical decisions (NSW, 2006). It provides fieldworkers, researchers, sponsors of projects, etc. with a code of conduct which they have to abide by. The goal is then to give guidance on appropriate behaviour by setting clear boundaries instead of trying to "change" people's ethical principles.

2.8.6. Guidelines for doing fieldwork

In this study, no fieldwork will be conducted. Fieldwork can be an entire study (within IK) on its own, and in this context, it can be seen as the recording and documenting of IK. The reason for including this section is to highlight some facts that should be kept in mind when designing the IK database. IK researchers are often "outsiders" working across cultures. Cross-cultural considerations are paramount and should influence the interview design. So, researchers will need to review and adapt these suggestions to the specific cultural context of their own research (Grenier, 1998:32).

Participatory Rural Appraisal (PRA) methods can reveal the hidden complexity of IK systems, but it is important to have a good sequencing of activities and an overall relaxed approach (Grenier, 1998:57). Thirty-one research techniques [guidelines] are described in Addendum 3 (Mascarenhas *et al.* cited in Grenier, 1998:58-62). According to Grenier's research guide, the set of techniques chosen for a research activity should answer to the International Union for the Conservation of Nature and Natural Resources' (IUCN) two core questions, "How are the people?" and "How is the ecosystem" (Grenier, 1998:57). Addendum 3 also includes a checklist for best practices compiled by the World Bank.

2.9. IK COMMUNITY PROTECTION - DEVELOPMENT MODEL

To protect the communities' IK, a protection model for gathering knowledge needs to be in place (along with the KM framework) for the organisations involved. The following community development model was proposed by the Research and Analysis Directorate for the Department of Indian Affairs and Northern Development in Canada. The document *A Community Guide to Protecting Indigenous Knowledge* by Brascoupé, Mann & Von Baeyer (2001) discusses ways to protect the community and its IK. The purpose of the document is to help researchers in their assignment of gathering IK and to try and guard against mistakes such as accidental exploitation of the communities involved. This IK model will help with implementing the IK component along with the KM framework because researchers will know what is expected of them with regards to the IK component.

The main focus of the guide is to help communities bring to life the critical concept that can underlie the preservation and protection of their knowledge. Community development is community action that is led by and for the people. A community development model that relies on traditional values and systems is a powerful tool. The main steps in the developmental model are: organisation, assessment, and action. The goal of applying a community development model is to empower communities so that they can preserve, control, protect, and share their IK through equitable and mutually beneficial relationships, if they so choose (Brascoupé *et al.*, 2001:10).

The stages of the IK development model are:

- community organising and planning;
- gathering and assessing information; and
- developing and implementing a community-based action plan (Brascoupé *et al.*, 2001:11-43).

2.9.1. Community organising and planning

Empowering local communities to protect and preserve their IK begins with community organising and planning. A number of important organisational goals to keep in mind are: working closely with the community, maintaining communications, achieving results, and providing concrete benefits and services.

In the first stage, the community will need to:

- understand what is meant by IK and its products;
- identify what organisational structures the community needs in order to understand the scope of its knowledge and to gather the knowledge; and
- determine what roles community members can play.

To begin the process, organisers must bring the people together. The first meeting is a major opportunity to set the process in motion and to inform, involve, and mobilise the community. If all goes smoothly, the first meeting will give the community the opportunity to choose a group that will form an organising committee to lead the IK initiative. Another consensus of the first meeting could be to assign responsibilities for collecting preliminary information on the community's IK (if a lead group/committee had been chosen). By virtue of the environment, history, and culture, each community's analysis will be different. The goal is to obtain facts and opinions. This first collection will provide some of the information needed to make informed decisions and to set the direction for further information gathering, organising and planning, and early actions (Brascoupé *et al.*, 2001:11-19). Addendum 4 contains a checklist with options that could help in identifying community-based IK.

2.9.2. Gathering and assessing information

Once the community has identified in a general way the IK goals and priorities, the next step is to assess the most appropriate community approaches for addressing the goals and priorities. No two communities are the same; therefore, no two sets of priorities will be the same and no two approaches will be exactly the same. Communities rich in arts will look for processes best suited for those areas;

communities rich in medicinal knowledge will look for tools suitable to preserve and protect the medicinal type of knowledge, and that could differ from the preservation of artistic knowledge.

The second stage focuses on answering major questions about using, sharing, preserving, and protecting the community's IK. The chosen committee should keep in mind that it is important to communicate the benefits the effort will provide to the community. One benefit is that the community can feel secure; they are developing a system to protect their knowledge and culture. A word of caution conveyed by the authors is that "developing an informed community may take several steps and many meetings. Preserving and protecting your IK is a long-term effort, which may take some time to get right". To preserve and protect IK, a community needs all the information they can gather. The goals and objectives that the community can support will be based on the gathered information (Brascoupé *et al.*, 2001:24-25).

The authors Brascoupé *et al.* stipulate that there are three main areas of research and that there are resources that will be needed to undertake the research. An outline of the three main areas, the research ideas, as well as resources needed is stipulated in Table 2.2.

AREA	RESEARCH IDEAS	RESOURCES NEEDED
Identifying IK and IK values	1. Full inventory of IK based on previously identified areas or categories. 2. Identifying the social, spiritual, and economic values of each area of IK. 3. Identifying economic opportunities of IK, if any exists and communities are willing to use their IK. 4. Ensuring the confidentiality of IK data.	1. Internal sources of IK. 2. Historical records and artefacts. 3. Elders to contextualise knowledge. 4. Expert advice on appropriate research and interview techniques. 5. Economic market analysis of value of IK/IK products.
Identifying IK to be shared and under what conditions.	1. Identify IK that can be shared and IK that cannot be shared. 2. Identify IK that can be shared within community, but not with outsiders. 3. Identify IK that can only be shared by specific persons and develop protocols for access to this knowledge. 4. Identify IK that can be shared with everyone, i.e. public knowledge.	1. Develop IK-sharing policy and guidelines. 2. Develop guidelines for accessing IK. 3. Develop process for [handling] confidential IK.
Identifying how IK can be preserved for future generations	1. Identify ways to record and preserve the knowledge. 2. Identify ways to educate youth and others. 3. Identify and build on the experience of other communities. 4. Ensure IK is stored in more than one area.	1. Archival research assistance. 2. Museum/library support. 3. Digitise IK for database. 4. Make digital and hard copies of IK resource materials.
Identifying how the community can protect its IK from abuse	1. Prepare internal and external research guidelines. 2. Identify applicable laws specific to community types of IK. 3. Identify other relevant legal mechanisms. 4. Identify legal resources that can assist in specific cases.	1. Legal research capacity inside/outside the community. 2. Develop research protocols and guidelines. 3. Collaboration with other research institutions.

Table 2.2 Research Objectives and Resources (Brascoupé *et al.*, 2001:29-30)

2.9.3. Developing and implementing a community-based action plan

In stages one and two, the goal had been community empowerment: to identify, preserve, manage, control, and in some case share IK. Stage three should lead to a strategic action plan that brings together all previous research and decision-making. This should be an action plan to preserve and protect IK, and the action plan should contain clearly stated objectives, tasks, resources, and time frames. The action plan must be implemented through the consent of the community (Brascoupé *et al.*, 2001:39). It is important that the community as a whole should consent to the general action plan for protecting IK. In designing the action plan, there are a few questions that should be considered:

- Has the consent-giving process been designed so that it is specific to each request for access to IK or local resources relating to IK?
- How should the economic climate of a potential researcher be reviewed?
- What specialised resources may be needed?
- Who should pay for the needed resources?
- What processes and support are available to determine which legal mechanisms should be used in any specific case to give consent and to protect community rights?
- Will the process identify other legal choices of toll to preserve and protect the IK?
- Does the process factor in how these choices can be enforced if there is a breach of a contract or an agreement that is used in the relationship?
- Does the process ensure that disputes can be resolved and avoided and that the success of a relationship can be monitored? (Brascoupé *et al.*, 2001:41).

With these questions answered and stages one and two completed, the committee can prepare a draft action plan and circulate the plan among community members. Suggestions as well as reasons for rejecting suggestions should be provided so that all members of the community can understand the reasons why a plan takes the shape it does. Once a plan has been approved by the community, the action plan can be implemented (Brascoupé *et al.*, 2001:42).

Knowledge as an instrument of development has not received the needed attention in developing countries in general and in Africa particular. In the past, the development policies of countries would typically focus on the adoption of Western practices with a view to modernising the society and transforming the productive sectors. As a result, there was very little systematic effort to promote indigenous practices in the development process (World Bank 1(d), 2006). The following diagram (Figure 2.8) is an illustrational representation of the model.

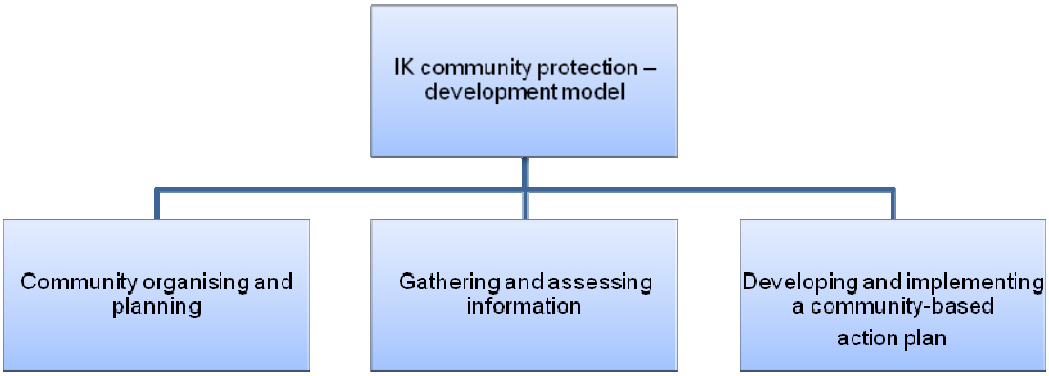


Figure 2.8 A development model for protecting the IK community

The above mentioned actions for IK development and the threefold KM framework can help to assist with the knowledge management within an organisation. The goal is to streamline the progress of developing an IK database and IK practices in its entirety. This is not to say that every situation and community that exist is the same. The recommended framework and IK actions or stages should be used as guidelines to develop a model for a community. Each individual situation needs to be assessed.

2.10. BEST PLAN FOR THE IMPLEMENTATION OF THE FRAMEWORK

Throughout this chapter, many aspects of KM and IK have been discussed. For a KM framework, the threefold framework was established as the best possible candidate to

implement in an organisation that works with IK. Other factors that have been discussed are information management, quality management, leading role players in the field of IK, IPR, ethics, etc. All the factors play a role when implementing the framework, but for the benefit of this discussion, the focus will be on the threefold framework as well as the model to protect and develop an IK community (discussed in section 2.9). Each organisation that would like to work in the field of IK will have to adapt the threefold KM framework (henceforth KM framework) and the model to protect and develop an IK community (henceforth IK model) to the needs of the organisation and communities involved. When implementing the KM framework, a life-cycle model for the KM framework can be of some assistance. In accordance with KM literature, five basic processes can be considered by managing knowledge. These processes can be defined as creating[1], sharing[2], structuring[3], using[4], and auditing[5], i.e. the 'knowledge management life cycle' model (Sağsan, 2006:3). The model provides an understanding of KM processes in a hierarchical order which is needed when implementing the framework. The following is a potential 'life cycle model' for the KM framework.

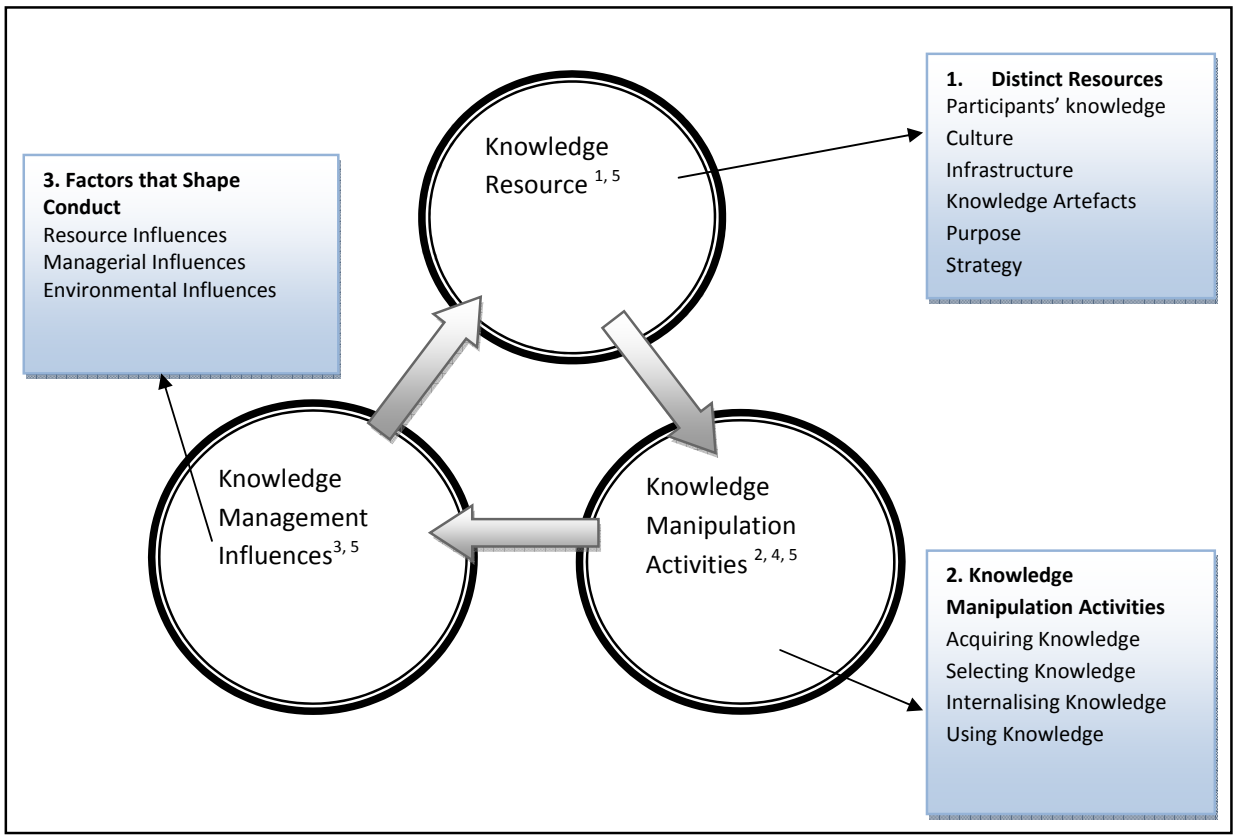


Figure 2.9 KM Threefold Framework Life Cycle Model

Table 2.1, the 'Compliance of the KM Framework with guidelines', should first be revised to improve on the structure of the KM framework before implementation. Once the KM framework is implemented in the organisation, the subsequent action is to determine which communities the organisation would like to consider for their first IK project and then implement the IK model with the help of the community; therefore there will be no attempt to do so in the dissertation at this point.

CHAPTER 3

Methodology and technical design of the IK database

3.1. INTRODUCTION

In the previous chapters, the focus was on IK and KM. In chapters 3 and 4, the focus is shifted to the prototype IK database and the technical design thereof.

The discussion in this chapter will start with a full methodology of the project to develop the prototype IK database. The method of analysis will include the importance and need for a well designed IK database in South Africa, what the significance of a template IK database for researchers is, how communities are currently being affected, and the purpose of the KM framework. The methodology will also refer to database design.

The rest of the chapter will be devoted to the design and development factors of the IK database. The starting point will be the Life Cycle, which have two components: the Systems Development Life Cycle (SDLC), which encompasses the entire ICT project, and the Database Life Cycle (DBLC), which will be the design and development of a database. Another factor that will be looked at is the four main stages of the database design, the conceptual design, the selection of Database Management System (DBMS) software, the logical design, and the physical design.

Thus far, the focus has been on how to support the database and what tools to use, but the focus now shifts to the more hands-on development by looking at the different data models and their underlying models that have to be evaluated before determining the best DBMS software to use. The study also focussed on the types of data to be stored in the database; the different data types have to be included in the database design from the start. It needed to determine the type of metadata schemas and which one to use by looking at the world standards and existing schemas.

Another aspect that will be discussed is the taxonomy and what the best way forward would be in that regard, because metadata schemas and taxonomies are not one and the same. The next step is to consider data security and levels of access, which is a crucial aspect of database design and development. Finally, the relationships between the entities will be discussed briefly.

3.2. METHODOLOGY

In recent years, the Department of Science and Technology (DST) has been spending time and effort on establishing an IKS policy that was adopted by cabinet in 2004. Since then, they have had regular workshops in order to establish the best possible route to safeguard IK in South Africa using the IKS policy as a basis. The vision and goals for the IKS policy are as follows: “the government of the Republic of South Africa registers its commitment to the recognition, promotion, development, protection and affirmation of IKS” (IKS policy, 2004:6). The IKS policy covers many aspects and one of them is the need to establish an IK database that will conform to standards and regulate the methodologies and standards used in IK systems and establish cross-referencing between these databases. The IKS policy states that “common standards would enable the integration of widely scattered and distributed references on IKS in a retrievable form. This would act as a bridge between indigenous and other knowledge systems” (IKS policy, 2004:33).

The need to develop a prototype IK database that can help standardise the work being done in the field of IK within South Africa has been established in the IKS policy. The goal is to design and develop a database that can be disseminated to researchers/organisations etc. working in the field of IK so that the researchers/organisations can use the database as a template, and consequently, the work in the field will be collected and based on the same model. The effect of using such a template database will be that researchers can become part of a large networked IK system in South Africa. The information is tagged uniformly, and there will be control of who is doing what in communities. Establishing guidelines and a modus operandi (KM framework) is important, especially when working with

communities. Researchers go into communities, gather their knowledge, and never return to the communities with their results. The communities feel enraged and wronged; creating an IK network can curb such behaviour or at least inform researchers/organisations that this behaviour is damaging. The communities can be protected by having researchers/organisations establishing links with the governing body. Another advantage is that information gathered by non-networked researchers (as is currently the case) can be 'lost in translation'. The researcher might leave the field or district, and the work done is mostly discarded. The purpose of the chapter is to design and develop such a prototype IK database and also to devise a KM framework for IK that can be used in conjunction with the database, in order to establish a knowledge flow that can be used to streamline the process of collecting and guarding information as well as help researchers/organisations with the process because not everyone can be specialists in the field of KM.

Database design is important because the structure of its contents must be designed carefully. A well-designed database facilitates data management and becomes a valuable information generator. A poorly designed database is likely to become a breeding ground for redundant data. A database contains redundant data when the same data about the same entity are kept in different locations. Redundant data leads to inconsistency in the database. For example, when the customers' telephone number is stored in the customer table, sales agent table, and invoice table and the telephone number is updated in one table but not the others, it can later lead to confusion about the correct telephone number for the customer. However, if the telephone number was only stored in one table i.e. customer table, the confusion would have been avoided (Rob & Carlos, 2004:9). The normalisation of a database ensures integrity.

The database design methodology has three phases, namely conceptual, logical, and physical database design. Conceptual database design is the process of constructing a model of information in an organisation, independent of all physical considerations. Logical database design is the process of constructing a model of information used in an organisation based on a specific data model, but independent of a DBMS and

other physical considerations. Finally, the physical database design is the process of producing a description of implementation of the database. Physical design describes the base relations, file organisation, and indexes design used to achieve efficient access to data, as well as any associated integrity constraints and security measures (Connolly & Begg, 2002:67-85).

The IK that will be stored in the database requires that methods, techniques, and procedures be in place. One other aspect of the process entails that the development of such a template or standardised database will make easy the integration of the system with other systems from across the world, if in future this is desired.

3.3. THE DESIGN PROCESS OF THE DATABASE

The discussion to follow has two parts: the SDLC which encompasses the entire ICT project that will flow from developing an IK database including screens, menus, user access, etc. and then the DBLC which will be the focal point because the focus of this thesis is the design and development of an prototype IK database and not the entire ICT project. The phases involved in both these life cycles will be discussed.

3.3.1. A System Development Life Cycle

The SDLC traces the history of an information system. The SDLC is divided into five phases: planning, analysis, detailed systems design, implementation, and maintenance (Rob & Carlos, 2004:398).

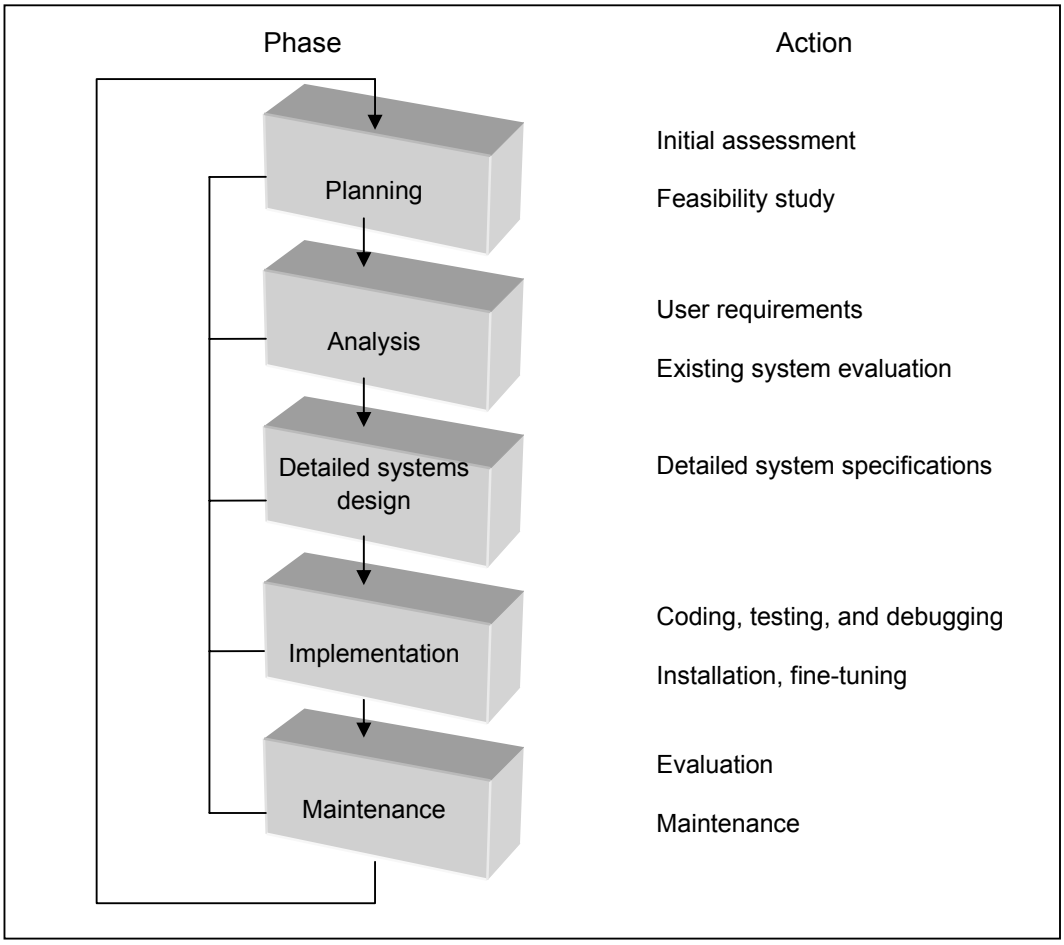


Figure 3.1 A System Development Life Cycle (Rob & Carlos, 2004:399)

3.3.1.1. Planning

The SDLC's planning phase yields a general overview of the organisation and its objectives. An initial assessment of the information flow and extent requirements must be made during this discovery portion of the SDLC. The assessment should include answering some important questions: "Should the existing system (if any) be continued? Should the existing system be modified? Should the existing system be replaced?" If it is decided that a new system is necessary, the question to be asked is: "Is it feasible?" The feasibility study must address the following: the technical aspects of hardware and software requirements and the cost of the system (Rob & Carlos, 2004:398). In Chapter

1 and 2, it was established that there is no standard database available for capturing IK in South Africa and that the need to preserve IK warrants the development of a standardised database. Some key problem areas that have been identified are that access to many of the existing IK databases are severely restricted, if not totally unavailable. The reason for this unavailability is that the information gathered and placed in the database is still the property of the community. IP laws therefore prohibit freely dispensing the knowledge to the general population, large companies, etc. Knowledge in the database collected from communities, stakeholders, etc. is lost because it is not tagged and it is stored incorrectly. Key players leave the field at an alarming rate. One finds duplication of field work and database development because there is no coordination between researchers in the field and because researchers are not collaborating. No correlation exists between existing databases either; therefore information becomes stagnant.

3.3.1.2. Analysis

Problems defined during the planning phase are examined in greater detail during the analysis phase. The analysis phase of the SDLC is a thorough audit of user requirements, which in this case includes the IK organisation that will manage the database and other ICT requirements as well as the community members who are the main users and beneficiaries of the database system. The users and system designers must work together to identify processes and to uncover potential problem areas. Such cooperation is vital to define the appropriate conceptual data model, input, processes and expected output requirements. The logical database design must specify the appropriate conceptual data model, input, processes, and expected output requirements (Rob & Carlos, 2004:399-400).

3.3.1.3. Detailed Systems Design

The system design phase entails the completion of the design of the system's processes. This includes all the necessary technical specifications for screens, menus, reports, and other devices that might be used to help make the system more efficient. The training principles and methodologies are also planned and form part of the system design phase (Rob & Carlos, 2004:400). In the technical specification of the database, possibilities of what the screens, menus, report, etc. should look like might be discussed, but that development is beyond the scope of the thesis; the focus is a prototype design and the development of the database and not the entire system that will be needed to run a project(s). However, a simple user interface will be developed to demonstrate the prototype IK database.

3.3.1.4. Implementation

During the implementation phase, the hardware, DBMS software, and application programs are installed, and the database design is implemented. During the initial stages of the implementation phase, the system enters into a cycle of coding, testing, and debugging until it is ready to be delivered. The actual database is created, and the system is customised by the creation of tables and views, user authorisations, and so on. The system is then subjected to exhaustive testing until it is ready for use. After testing is concluded, the final documentation is reviewed and printed, and end users are trained. The system is in full operation at the end of this phase but will be continuously evaluated and fine-tuned (Rob & Carlos, 2004:400). A prototype database will be developed but the rest of the implementation phase is also beyond the scope of this thesis.

3.3.1.5. Maintenance

Almost as soon as the system is operational, end users begin to request changes in the system. Those changes generate system maintenance activities, which can be grouped into three types:

- corrective maintenance – in response to system errors;
- adaptive maintenance – due to changes in the business environment; and
- perfective maintenance – to enhance the system (Rob & Carlos, 2004:401).

The maintenance phase will be a continuous phase because there are always factors changing, and as a result, the SDLC is in a continuous never-ending cycle.

The SDLC encompasses the entire ICT project that has to be implemented in order for users to benefit from the IK database. The next step is to look at the DBLC and discuss the phases involved in more detail because that is what will be developed. Once the database is developed, it will slot into its place in the SDLC.

3.3.2. Database Life Cycle

Within the larger information system, the database, too, is subject to a life cycle. The DBLC contains six phases: database initial study, database design, implementation and loading, testing and evaluation, operation and maintenance, and evolution (Rob & Carlos, 2004:401).

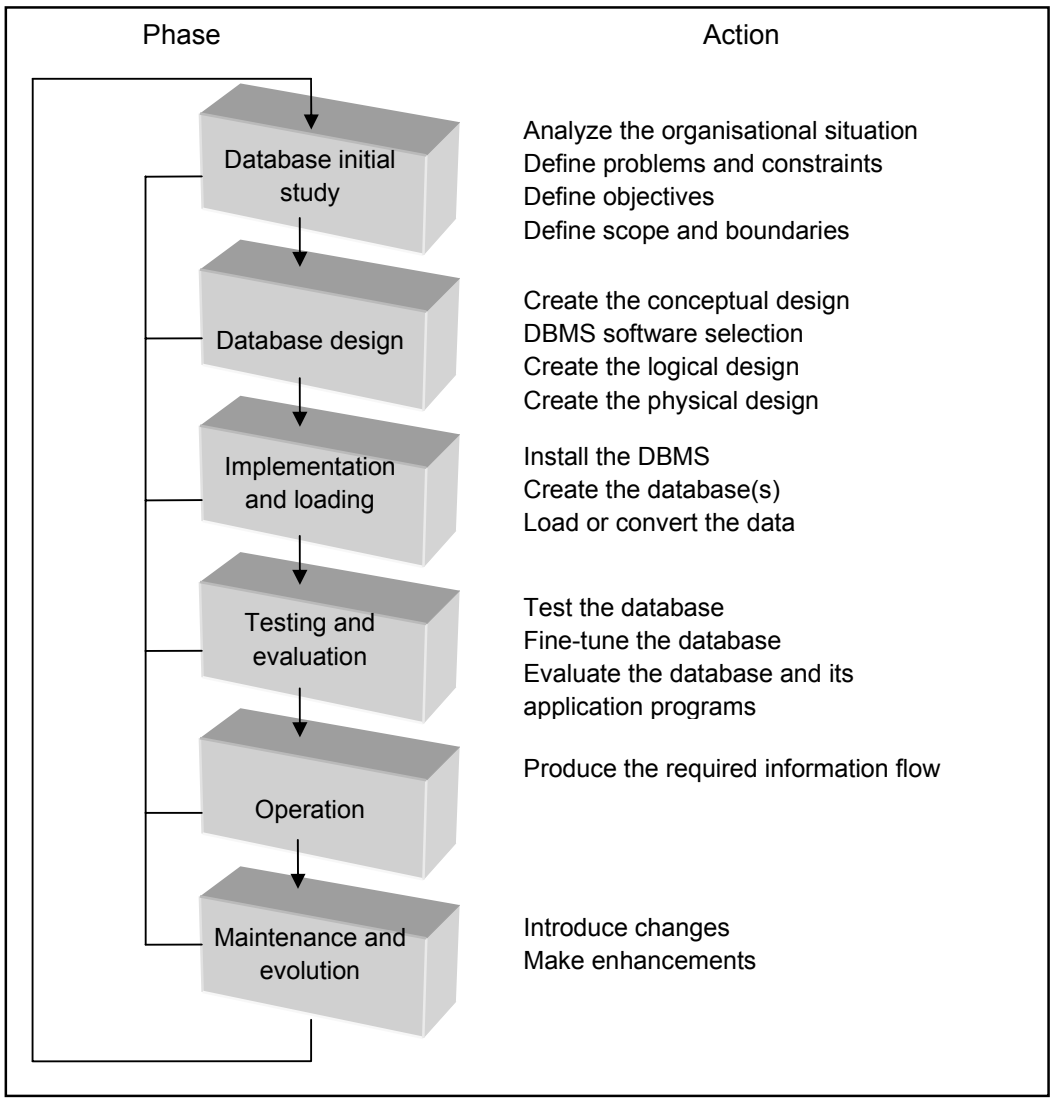


Figure 3.2 The Database Life cycle (Rob & Carlos, 2004:402)

3.3.2.1. Initial study about the database

The database designer has to determine why the current system (if there is one) is failing, and how the current system works. The way to do that is to spend a lot of time talking with end users. Although there are some existing IK databases (as discussed in Chapter 2) in South Africa, the databases are either not available to the general public or lost to users. Available databases were also investigated in the Frelico report done in 2006 and 2007 in which the findings confirm that none of the existing (available) databases meets requirements. Database design is a very technical business; it is also very

people-oriented. Database designers must be excellent communicators, and they must have finely tuned interpersonal skills. This is especially the case when working with communities; the communities will be distrusting of the designers' motives and will not open up easily. Trust will have to be won by the designer, and he/she will have access to users only after a plan of action for IK has been set in place in that particular community (Rob & Carlos, 2004:401-402).

3.3.2.2. Database design

The second phase focuses on the design of the database model that will support organisational operations and objectives. The most critical part of the phase is making sure that the final product meets user and system requirements. In the process of database design, the focus should be on the characteristics of the data required to build the database model. Defining data is an integral part of the phase of database design. When examining the procedures that are required to complete the design phase in the DBLC, one should remember that:

- The process of database design is loosely related to the analysis and design of a larger system. The data component is only one element of a larger information system.
- The systems analysts or systems programmers are in charge of designing the other system components. Their activities create the procedures that will help transform the data within the database into useful information.
- The database design does not constitute a sequential process. Rather it is an iterative process that provides continuous feedback designed to trace previous steps.

Within the design phase of the database, there is a procedural flow that has to be adhered to. The following figure represents the procedural flow of the database design (Rob & Carlos, 2004:406-407).

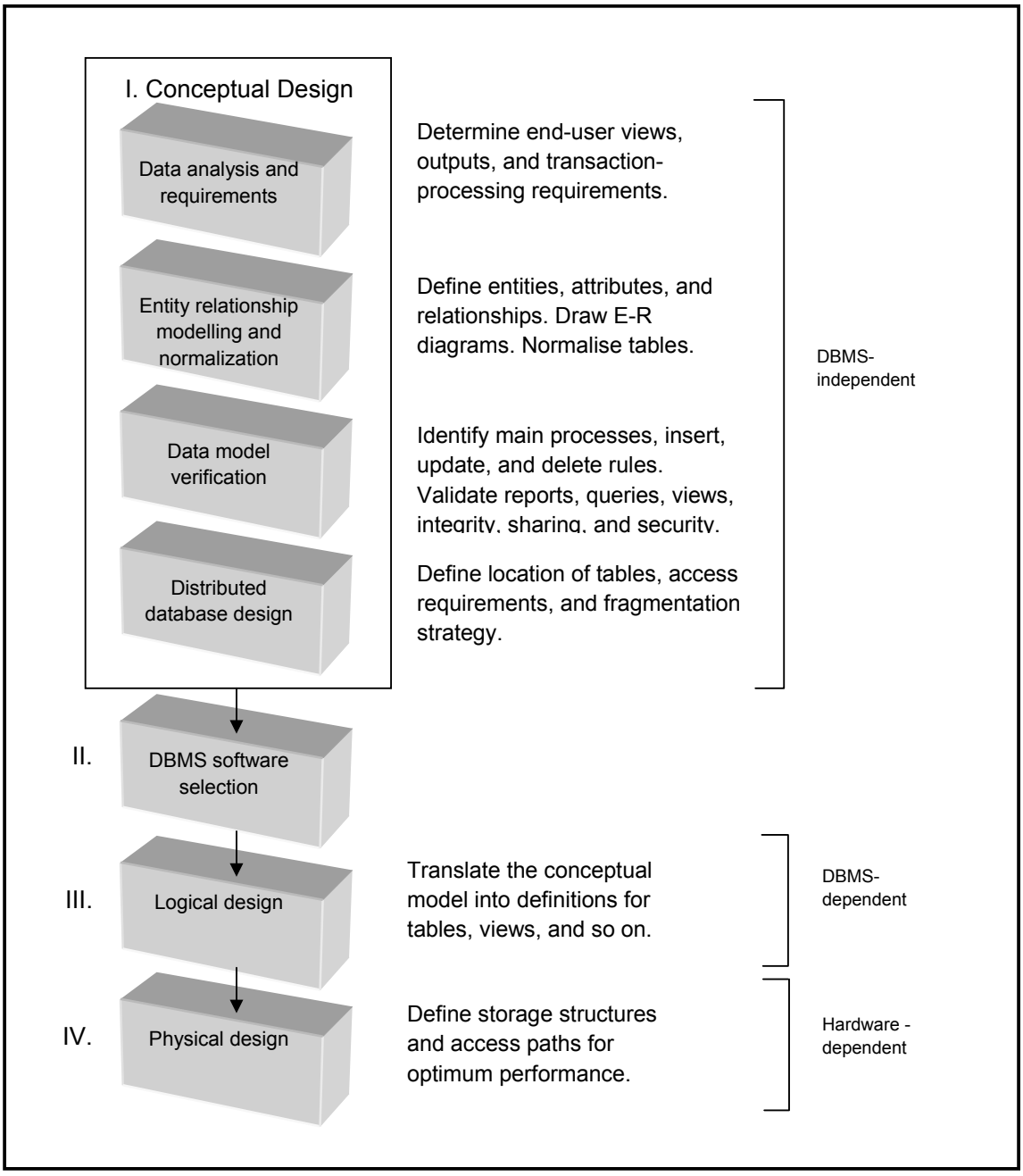


Figure 3.3 Procedure Flow in Database Design (Rob & Carlos, 2004:407)

The four main stages are conceptual design, DBMS software selection, logical design, and physical design.

In the conceptual design stage, data modelling is used to create an abstract database structure that represents real-world objects in the most authentic way

possible. The conceptual model must embody a clear understanding of the business and its functional areas. At this level of abstraction, the type of hardware and/or database model to be used might not have been identified. Therefore, the design must be software and hardware independent, so that the system can be set up within any hardware and software platform chosen later (Rob & Carlos, 2004:408). In Chapter 4, the conceptual design of the IK database will be presented in the form of a Conceptual Data Model (CDM).

The selection of DBMS software is critical to the smooth operation of the information system. Consequently, the proposed DBMS software's advantages and disadvantages should be studied carefully. The end user must be made aware of the limitations of both the DBMS and the database in order to avoid false expectations. Some of the most common factors that will affect the purchasing decision are: cost, DBMS features and tools, the underlying model (hierarchical, network, relational, entity relationship, object-oriented), portability, and DBMS hardware requirements (Rob & Carlos, 2004:417 - 418). In section 3.4, the choice of DBMS software will be discussed.

The logical design follows the decision to use a specific database model. Once the database model is identified, the conceptual design can be mapped onto the logical design that is tailored to the selected database model. Logical design is therefore used to translate the conceptual design (software-independent) into the internal model for a selected DBMS (software-dependent). The right to use the database is also specified during the logical design stage. (Rob & Carlos, 2004:418). The choice of database model will be discussed in section 3.4, and the implementation of the logical design will commence in Chapter 4.

Physical design is the last stage in the procedure flow of the database design. Physical design is the process of selecting the characteristics of the database that pertain to data storage and data access. The storage characteristics are a function of the types of devices supported by the hardware, the type of data

access methods supported by the systems, and the DBMS. Physical design affects the location of the data in the storage device(s) as well as the performance of the system. Physical design is best described as a very technical job, but modern database software has assumed much of the burden of the physical portion of the design and its implementation (Rob & Carlos, 2004:420).

3.3.2.3. Implementation and loading

Implementation requires the building of the database with the DBMS software. This requires the creation of the database and tables and assigning rights to use the database (administrators for instance). After the database has been created, existing data (if any) must be loaded into the database tables. During the implementation and loading phase, the following factors must be addressed:

- Performance – Database performance is one of the most important factors in certain database implementations. Important factors in database performance include system and database configuration parameters, such as data placement, access path definition, use of indexes, and buffer size.
- Security – Data stored in the organisational database must be protected from access by unauthorised users. Types of security include physical security, password security, access rights, audit trails, data encryption, and diskless workstations.
- Backup and recovery – The database can be subject to data loss through unintended data deletion, power outages, load shedding, etc. Data backup and recovery procedures create a safety regulator, allowing the database administrator to ensure the availability of consistent data.
- Integrity - Data integrity is enforced through the proper use of primary and foreign key rules.
- Organisational standards – Database standards may be partially defined by specific organisational requirements. The database administrator must implement and enforce such standards.

- Concurrency control – The feature allows simultaneous access to a database while preserving data integrity and concurrency control. Failure to maintain concurrency control can quickly destroy a database's effectiveness (Rob & Carlos, 2004:423-424).

The factors discussed above will need to be adhered to when the IK database is implemented in an organisation.

3.3.2.4. Testing and evaluation

Once the data have been loaded into the database, the Database Administrator (DBA) tests and fine-tunes the database for performance, integrity as well as concurrent access and security constraints. The testing and evaluation phase occurs in parallel with applications programming. Applications are the software (graphical user interface) that will use the database as a repository. It could be one or many software packages. As stated before, there will be a prototype user interface designed to illustrate how to add a new member to the system, how data can be uploaded and searched for in the IK database (see Chapter 4).

The DBA can consider one or more of the following options to enhance the system if the database implementation fails to meet some of the system's evaluation criteria: fine-tuning specific system and DBMS configuration parameters for performance-related issues, modifying the physical design, modifying the logical design, or upgrading/changing the DBMS software and/or hardware.

3.3.2.5. Operation

Once the database has passed the evaluation stage, it is considered to be operational. At this point, the database, its management, its users, and its application programs constitute a complete information system. The beginning of the operational phase invariably starts the process of system evolution. As soon as all the targeted end users have entered the operations phase,

problems that could not have been foreseen during the testing phase begin to surface. The changes could warrant emergency patchwork while minor changes leads to phase six, i.e. maintenance and evolution (Rob & Carlos, 2004:425).

3.4. TYPES OF DATA MODELS

This section focuses on the different types of data models. A data model is the simple representation (usually graphically) of complex, real-world data structures. The basic building blocks of all data models are entities, attributes, and relationships. An entity is anything, such as a person, place, thing, or event about which data are to be collected and stored. An attribute is a characteristic of an entity, such as a person's last name, first name, telephone number, etc. There are three types of relationships within the data model, one-to-one (1:1), many-to-many (M:N), and one-to-many (1:M) relationships (Rob & Carlos, 2004:30-31).

Traditionally, database designers have relied on good judgement to help them develop a good design; unfortunately good judgement is often in the eye of the beholder. The development of data models, supported by powerful database design tools, has made it possible to diminish the potential for error in database design (Rob & Carlos, 2004:30). The prototype IK database's conceptual design will be done using a tool called PowerDesigner – DataArchitect Version 6. The CDM represents a global view of a database, which is independent of any software or data storage structure. A CDM also represents the organization of data in a graphical format, verifies the validity of data design, and generates the Physical Data Model (PDM) which specifies the physical implementation of the database (PowerDesigner, 1997). As previously stated, the CDM is platform independent. Next, a discussion will follow on the different data models, and how the models have evolved from predecessors, followed by a choice of data model to be used.

Each data model evolved from its predecessors (Figure 3.4). The evolution of database management has always been driven by the search for new ways of

modelling increasingly complex real-world data (Rob & Carlos, 2004:33-53). Every new model capitalised on the shortcomings of the previous models.

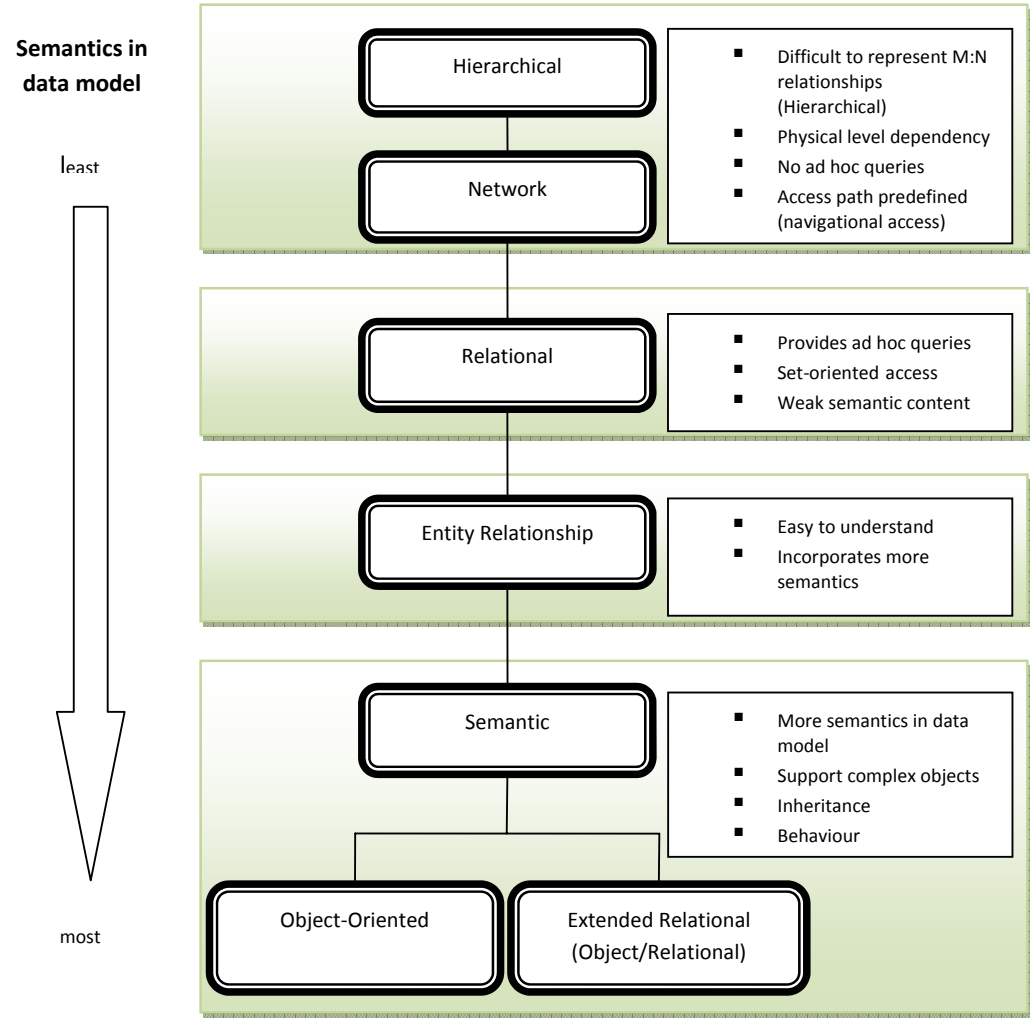


Figure 3.4 The development of data models (Rob & Carlos, 2004:53)

The network model replaced the hierarchical model because the former made it much easier to represent complex (M:N) relationships. The relational model offered several advantages over the hierarchical and network models through its simpler data representation, superior data independence, and relatively easy-to-use query language (Rob & Carlos, 2004:54). The following table (Table 3.1) is a summarised representation of each of the models showing the basic structure, advantages, and disadvantages of each.

DATBASE MODEL	STRUCTURAL INDEPENDENCE	BASIC STRUCTURE	ADVANTAGES	DISADVANTAGES
Hierarchical	No	1. A hierarchical database is based on a tree structure that is composed of a root segment, parent segments, and child segments. 2. The segment is equivalent to a file's record type. The hierarchical database model depicts a set of 1:M relationships between a parent and its children. 3. The hierarchical model uses a hierarchic sequence or pre-order traversal to navigate through its structures, always starting at the left side of the tree (Rob & Carlos, 2004:35).	1. Promotes data sharing. 2. Conceptual simplicity is promoted by parent/child relationship. 3. Parent/child relationship promotes database integrity. 4. Efficiency with 1:M fixed relationships.	1. Navigational system yields complex design, implementation, application development, use, and management. 2. Implementation limitations (no M:N or multi-parent relationships). 3. No data definition or data manipulation language in DBMS. 4. Lack of standards.
Network	No	1. The network model resembles the hierarchical model; its structure easily accommodates the multi-parent child. 2. The integrity of the model's data is ensured by the fact that a member record cannot exist without its owner. 3. The network set defines the relationships between owner and member; its existence allows a program to access an owner record	1. Conceptual simplicity at least equal to that of the hierarchical model. 2. Handles more relationship types: M:N and multi-parent. 3. Owner/member relationship promotes database integrity. 4. Conformance to standards. 5. Includes data definition language	1. System complexity limits efficiency (still a navigational system). 2. Navigational system yields complex design, implementation, application development, use, and management.

		and all the member records within a set, thus yielding greater data access and flexibility than was possible with the hierarchical model (Rob & Carlos, 2004:39).	(DDL) and data manipulation language (DML) in DBMS.	
Relational	Yes	1. The relational database management system (RDBMS) is so sophisticated that the user/designer needs only be concerned with the logical view of the database. 2. Details of physical storage, access paths, and data structures are managed by the RDBMS. 3. Relational database design becomes much simpler than with the hierarchical or network design. 4. It hides the system's complexity from the user/designer. A relational database exhibits both data independence and structural independence. Data management becomes much easier than with earlier models (Rob & Carlos, 2004:41).	1. Tabular view substantially improves conceptual simplicity, thus promoting easier design, implementation, management, and use. 2. Ad hoc query capability based on Structured Query Language (SQL). 3. Powerful database RDBMS improves implementation and management simplicity.	1. The RDBMS that makes the system easy to use requires substantial hardware and system software overhead. 2. Conceptual system simplicity gives relatively untrained people the tools to use a good system poorly. 3. May promote "islands of information" problems as individuals and departments find it easy to develop their own applications.
Entity-relationship (ER)	Yes	1. Increasingly complex databases created a need for a more easily interpreted graphic conceptual environment.	1. Visual modelling yields exceptional conceptual simplicity. 2. Visual representation makes it an	1. Limited constraint representation. 2. Limited relationship

		2. The entity-relationship model (ERM) is particularly valuable because it is based on a visual presentation of data and their relationships. 3. ERM yields an easily understood conceptual view of the database's entities and relationships. Complex database designs are more easily created and managed. 4. ERM integrated well with the still-dominant relational database model (Rob & Carlos, 2004:45).	effective communication tool. 3. Integrated with dominant relational database model.	representation. 3. No data manipulation language. 4. Loss of information content because attributes are usually removed to avoid crowded displays (This limitation has been addressed in subsequent graphic versions).
Object-oriented (OO)	Yes	1. An object resembles an entity in that it includes the facts that define it, but unlike an entity, the object also includes information about relationships between the facts as well as relationships with other objects thus giving the data more meaning. 2. An object has greater semantic content than the entities used in earlier data models. 3. Objects that share similar characteristics are grouped in classes. These classes share a structure and behaviour. 4. The class hierarchy structure allows each	1. Add semantic content. 2. Visual representation includes semantic content. 3. Inheritance promotes database integrity.	1. Slow development of standards caused vendors to supply their own enhancements, thus eliminating a widely accepted standard. 2. Complex navigational system. 3. Steep learning curve. 4. High system overhead slows transactions.

	object within the hierarchy to inherit the attributes, relationships, and methods of the classes above it, ensuring data integrity. 5. Given the increased semantic content and methods, objects are potentially the building blocks for autonomous structures, making modular design and implementation possible (Rob *et al.*, 2004:49).

Table 3.1 A tabular depiction of database models, basic structure, advantages and disadvantages (Rob & Carlos, 2004: 56)

The hierarchical and network models are both part of an era gone by and will not be considered as possible models for the IK database. According to Rob & Carlos (2004), the relational model is the current standard for implementing databases. This statement was made in 2004, and since then, the relational model has emerged as the dominant data model. Another reason for the popularity of relational databases is the well-established, standardised structure query language (SQL) (Huang & Mark, 2001:132). It seems safe to say that the pitfalls of object-oriented (OO) models, i.e. a lack of standards, a difficult navigational environment as far as data access is concerned, and relatively slow transaction speeds caused by high system overhead have prevented its wide acceptance as a database standard (Rob & Carlos, 2004:54-56).

In an article called *Whatever happened to object-oriented databases?,* Neal Leavitt discusses some of the same issues covered up to now. One aspect that he mentions in particular is that OO databases have cornered a small niche market that has no broad appeal. RDBMS vendors began developing and marketing Entity-Relationship (ER) databases (in part) in response to the perceived threat from OO databases. ER databases work via an object layer that sits atop a conventional tabular relational database, so in addition to handling the numerical data generally used in relational databases, OR databases can handle multimedia data types (Leavitt, 2000:16-18). Therefore, the choice of a database model for the development of the IK database in this study is the relational database model in conjunction with the database design tools offered by the ER model. Some of the popular relational model RDBMSs are: MySQL, Oracle, and Microsoft SQL server (Ali, Anjum, Azim, Bunn Iqbal, McClatchey, Newman, Shah, Solomonides, Steenberg, Thomas, Van Lingen & Willers, 2007:35).

The principles of the relational model will be the guiding principles for designing the database, and the structure can then be implemented in any of the above mentioned relational model RDBMSs. In a project conducted in

2006 and 2007 by the University of the Free State, commissioned by Frelico (Free State Library and Information Consortium) to determine the viability of the development of a database of IK in the Free State (and South Africa), the project team compared available RDBMS software packages and concluded that if and when a database is compiled, the best software to use would be MySQL. DB/TextWorks' InMagic, MySQL, and Oracle are the three chosen databases evaluated for their features, advantages, and disadvantages. The comparison clearly showed that all three candidates are exceptional database software packages that compared well with each other on almost all levels. MySQL is constantly being developed and improved, and the cost is minimal. MySQL's consistent fast performance, high reliability, and ease of use make it one of the best databases in the world. In an IKS development, cost plays an important role. If the development software used is expensive, it would be improbable that libraries, community centres, etc. would be able to carry the cost of licensing fees to continually use the system, and if the government pays for it, it will cost South Africa millions in the long run (Cawood, Ehlers & Nel, 2007:40-41). Table 3.2 lists the features, advantages, and disadvantages that the MySQL DBMS have.

There is one more reason for choosing MySQL and that is because of the South African government's open source policy. In 2003, a proposed strategy compiled by the Government Information Technology Officers' Council (GITOC) concluded that the role of open source software (OSS) should be explicitly recognised in e-Government policy (GITOC, 2003:1). This strategy to implement Free and Open Source Software (FOSS) was approved as a policy by cabinet in 2007 (Open Source, 2007). GITOC states that some of the values OSS can offer are 1) economic value including greater efficiency, saving of foreign currency, and possible savings on acquisition; and 2) social value including wider access to information and providing an instrument for IT training (GITOC, 2003:2). The Council for Scientific and Industrial Research (CSIR) and the Department of Science and Technology (DST) are all moving towards the use of open source software as well as encouraging other

organisations big and small to do the same. The CSIR is taking this initiative so seriously that they have a created a centre dedicated to the cause (Cawood *et al.*, 2003:38).

Features
- MySQL works on many different platforms: API's for C, C++, Eiffel, Java, Perl, PHP, Python, Ruby, Tcl, and Visual Basic. - MySQL has a very fast B-tree disk table with index compression and a thread-based memory allocation system. - MySQL is fully multi-threaded using kernel threads, which means it can easily use multiple CPU's if available. - MySQL has a very fast join using an optimised one-sweep multi-join. Different tables from databases can be joined in the same query. - *Security:* All password traffic is encrypted connecting to a server. It boasts a privilege and password system that is very flexible and allows host-based verification. - *Localization:* All comparisons for normal string columns are case-insensitive. MySQL Server supports many different character sets that can be specified at compile and runtime.
Advantages
- *It's easy to use*: While a basic knowledge of SQL is required, most relational databases require the same knowledge. MySQL is very easy to use. With only a few simple SQL statements, you can build and interact with MySQL. - *It's secure*: MySQL includes solid data security layers that protect sensitive data from intruders. Rights can be set to allow some or all privileges to either individuals or groups. Passwords are encrypted. - *It's inexpensive*: MySQL is an open source database and available for free download. - *It is fast*: In the interest of speed, MySQL designers made the decision to offer fewer features than other major database competitors, such as Sybase and Oracle. However, despite having fewer features than the other commercial database products, MySQL still offers all of the features required by most database developers. - *It's scalable*: MySQL can handle almost any amount of data, up to as much as 50 million rows or more. The default file size limit is about 4 GB. However, you can increase this number to a theoretical limit of 8 TB of data. - *It manages memory very well*: MySQL server has been thoroughly tested to prevent

memory leaks. - *It supports Novell Cluster Services*: MySQL on NetWare runs effectively with Novell® Cluster Services™, letting you add your database solution to a Novell cluster. If one server goes down, MySQL on an alternate server takes over and your customers will not know that anything has happened. - *It runs on many operating systems*: MySQL runs on many operating systems, including Novell NetWare, Windows, Linux and many varieties of UNIX (such as Sun Solaris, AIX, and DEC UNIX), OS/2, FreeBSD, and others.
Disadvantages
- One disadvantage that accompanies open source software is the fact that there is no one to support the code if an error occurs. In contrast to other software, open source software is not owned by a one particular entity, and therefore support agreements and technical support may not be readily available. This could lead organizations to searching for resolutions to problems wherever they can find them. If an error occurs, the users of the software will often have to dig into the source code and find the cause of the error unless they can find a patch, fix, or solution already available. This could lead to costly delays in time and resources. - Another disadvantage of open source software is the fact that, since the source code to the application is readily available to the public, it is also available to those who may use it to find weaknesses in the product. They can use these weaknesses in an attempt to exploit problems with it and possibly inflict harm or damage to the information that an organization may house. Due to this fact, the applications often require extra steps and precautions in order to secure the resources. - The final disadvantage of open source software is the fact that many companies who use open source software must rely on someone else to make the changes that they may need because they lack the technology and resources to do so. This can become costly in terms of time and money while searching for, negotiating with, and securing someone to make the changes that are needed.

Table 3.2 Features, Advantages and Disadvantages of MySQL (Cawood *et al.*, 2007. Addendum 4)

3.4.1. Data to be stored in the database

To determine the type of data that will be stored in the database, one can look at the recording process. The techniques for collecting IK can yield an excessive amount of information; not all of it useful. It is important to have clear research objectives and some knowledge of the subject area (Grenier, 1998:57). Ways to record information or rather research techniques have

already been discussed in some detail in Chapter 2. Addendum 3 contains a list of these methods. The purpose now is to determine what type of data those techniques will deliver in order to determine data type needs for use in the database design. From the research techniques (PRA methods) in Addendum 3, the following can be determined: interviews, questionnaires, observation (folklore, dancing, and working), diagrams (maps, photos, and charts), seasonal calendars, etc. will be used to collect information. The different methods used to record information shows that the design of the database will need to include storage for the following: numeric characters, alpha-numeric characters, video and sound files, photos, and diagrams. All these mediums will be used to record information and should be included in the design.

3.4.2. Standard metadata schema

Metadata is data about data, through which the data are integrated. The metadata provide a description of the data characteristics and the set of relationships that link the data found within the database (Rob & Carlos, 2004:7).

When organising information, it is commonly assumed that it consists of discrete pieces, i.e. a piece can be a document or an object. In the context of this thesis, the term object will be used, the reason being that assuming that all the information is documents in the traditional sense does not seem appropriate. As indicated above, metadata is defined as ‘data about data’, which is a very broad definition. In computer science this is generally taken to mean information about a set of data in a particular representation, which typically means schema information, administrative information, etc. In content management and information architecture, metadata means ‘information about objects’, that is, information about a document, an image, etc. The first definition of content management, information about an object, will be used when discussing IK, and the second, data about data, will be used when working with database logistics. In general, metadata is best understood as

'any statement about an information resource', regardless of what it is being used for, which metadata vocabulary is being used, and how the metadata is represented (Garshol, 2004: 379).

There are several types of metadata schemas already in existence. Most of the existing metadata schemas have been created for a specific field. The following table (Table 3.3) lists some existing metadata schemas and gives a brief description of each.

Dublin Core	
Description	Primary Use
The best-known vocabulary for metadata is Dublin Core, which is a set of thirteen properties that may be applied to information sources to describe them. These properties contain information such as: title, creator, subject, description, publisher, date, language, etc. The Dublin Core specification defines the meaning of each property, but it is silent on how to represent both the properties and their values and is thus independent of any particular technology (Garshol, 2004:379). Dublin Core may provide the core to which extensions may be added (Taylor, 2003). The Dublin Core element set has been kept as small and simple as possible to allow a non-specialist to create simple descriptive records for information resources easily and inexpensively, while providing for effective retrieval of those resources in the networked environment (Hillmann, 2005).	Dublin Core has received widespread acceptance amongst the resource discovery community and has become the de facto Internet metadata standard (Taylor, 2003).
AACR2	
Description	Primary Use
The Anglo-American Cataloguing Rules (AACR) is designed for use in the construction of catalogues and other lists in general libraries of all sizes (AACR2, 2006). The rules are divided	The AACR2's primary use is that it is a detailed set of standardized rules for cataloguing various types of library materials (Sutch, 2006:1).

into two parts: rules for creating the bibliographic description of an item of any type, and rules governing the choice and form of entry of headings or access points in the catalogue (Sutch, 2005). The rules cover the description of and the provision of access points for all library materials commonly collected at the present time. The second edition of the rules is based on a reconciliation of the British and North American texts of the 1967 edition. This extends to style, which is generally in accordance with the Chicago Manual of Style, and to spelling, which are those of Webster's New International Dictionary. Part I deals with the provision of information describing the item being catalogued, and Part II deals with the determination and establishment of headings (access points) under which the descriptive information is to be presented to catalogue users and with the making of references to those headings. In both parts, the rules proceed from the general to the specific (AACR2, 2006).	
MARC 21	
Description	Primary Use
The MARC 21 formats are standards for the representation and communication of bibliographic and related information in machine-readable form. A MARC record involves three elements: the record structure, the content designation, and the data content of the record. The structure of MARC records is an implementation of national and international standards, e.g. Information Interchange Format (ANSI Z39.2) and Format for Information Exchange (ISO 2709). Content designation, the codes and conventions	A MARC 21 format is a set of codes and content designators defined for encoding machine-readable records. Formats are defined for five types of data: bibliographic, holdings, authority, classification, and community information. Format for: - bibliographic data: It contains format specifications for encoding data elements needed to describe, retrieve, and control various forms of bibliographic material. Bibliographic data is an integrated format defined for the identification and description of different forms of bibliographic

established to identify explicitly and characterize further the data elements within a record and to support the manipulation of those data, is defined in the MARC 21 formats. The content of most data elements is defined by standards outside the formats, e.g., Anglo-American Cataloguing Rules, Library of Congress Subject Headings, and National Library of Medicine Classification. The content of other data elements, e.g. coded data, is defined in the MARC 21 formats (MARBI, 1996).	material. MARC 21 specifications are defined for books, serials, computer files, maps, music, visual materials, and mixed material. With the full integration of the previously discrete bibliographic formats, consistent definition and usage are maintained for different forms of material. - holdings data: It contains format specifications for encoding data elements pertinent to holdings and location data for all forms of material. - authority data: It contains format specifications for encoding data elements that identify or control the content and content designation of those portions of a bibliographic record that may be subject to authority control. - classification data: It contains format specifications for encoding data elements related to classification numbers and the captions associated with them. Classification records are used for the maintenance and development of classification schemes. - community information: It provides format specifications for records containing information about events, programs, services, etc. so that this information can be integrated into the same public access catalogues as data in other record types (MARBI, 1996).
METS	
Description	Primary Use
The Metadata Encoding & Transmission Standard (METS) schema is a standard schema for encoding descriptive, administrative, and structural metadata for textual and image-based works expressed using the XML schema language of the World Wide Web (WWW) Consortium. METS, a Digital Library Federation initiative, attempts to build upon the work of Making of America II (MOA2) and provides an XML document format for encoding metadata	Depending on its use, a METS document could be used in the role of Submission Information Package (SIP), Archival Information Package (AIP), or Dissemination Information Package (DIP) within the Open Archival Information System (OAIS) Reference Model (METS, 2006).

necessary for both the management of digital library objects within a repository and the exchange of such objects between repositories (or between repositories and their users). The standard is maintained in the Network Development and MARC Standards Office of the Library of Congress, and is being developed as an initiative of the Digital Library Federation (METS, 2006).	
MODS	
Description	Primary Use
Metadata Object Description Schema (MODS) may be used for a variety of purposes and particularly for library applications. As an XML schema, it is intended to be able to carry selected data from existing MARC 21 records as well as to enable the creation of original resource description records. It includes a subset of MARC fields and uses language-based tags rather than numeric ones, in some cases regrouping elements from the MARC 21 bibliographic format. This schema is currently in draft status. MODS are expressed using the XML schema language of the WWW Consortium (MODS, 2008).	MODS could potentially be used as follows: as an Search/Retrieval via URL (SRU) specified format; an extension schema to METS; to represent metadata for harvesting for original resource description in XML syntax; for representing a simplified MARC record in XML and for metadata in XML that may be packaged with an electronic resource (MODS, 2008).

Table 3.3 Existing Metadata schemas

There are literally hundreds of metadata schemas to choose from and the number is growing rapidly as different communities seek to meet the specific needs of their members. Recognising the need to answer the question pertaining to the definition of a simple metadata record that sufficiently describes a wide range of electronic documents, the Online Computer Library Center (OCLC) combined with the National Center for Supercomputing Applications (NCSA), sponsored the first Metadata Workshop in March of 1995 in Dublin, Ohio. The primary outcome of the workshop was a set of thirteen elements (subsequently increased to fifteen) named the Dublin

Metadata Core Element Set (known as Dublin Core). Dublin Core (DC) was proposed as the minimum number of metadata elements required to facilitate the discovery of document-like objects in a networked environment such as the Internet or rather the World Wide Web (Taylor, 2003). Taylor also states that the "Dublin Core has received widespread acceptance amongst the resource discovery community and has become the de facto Internet metadata standard". In 2003, the DC metadata element set became an International Organization for Standardization (ISO) standard. The DC metadata set (ISO 15836:2003) is for the element set only, which is generally used in the context of a specific project or application. Local or community based requirements and policies may impose additional restrictions, rules, and interpretations. It is not the purpose of ISO 15836:2003 to define the detailed criteria by which the element set will be used with specific projects and applications (ISO, 2008). Therefore, DC can still be adapted to fit the needs of the project, even if it is a registered ISO standard. The organisation responsible for the DC is called the Dublin Core Metadata Initiative (DCMI). DCMI is an organization dedicated to promoting the widespread adoption of interoperable metadata standards and developing specialized metadata vocabularies for describing resources that enable more intelligent information discovery systems (DCMI (a), 2008). DC metadata is being used as the basis for descriptive systems by several community interest groups such as: educational organisations, libraries, government institutions, the scientific research sector, web page authors, businesses requiring more searchable sites, and corporations with vast knowledge management systems (DCMI (b), 2008).

As far as can be ascertained, the DC metadata scheme is the most widely used schema of all. That is not to say that researchers/developers and other people use the schema as is, rather they start with DC as their basic metadata schema and adapt it by adding new elements as needed for their particular research/development.

A very useful service offered by the DCMI is their tools and software packages that is created and maintained by the DCMI Tools community. Some of these tools and software offered are:

- templates for creating metadata;
- tools for the creation/change of templates;
- automatic extraction/gathering of metadata;
- automatic production of metadata; and
- conversion between metadata formats (DMCI (c), 2008).

Below is a summary and description of the basic elements in DC (Table 3.4). The metadata elements fall into three groups which roughly indicate the class or scope of information stored in them:

1. elements related mainly to the content of the resource;
2. elements related mainly to the resource when viewed as IP; and
3. elements related mainly to the physical manifestation of the resource.

Content & about the resource	Represented as the following in an IK database description of element	Intellectual property	Dublin Core description of element	Electronic or physical manifestation	Dublin Core description of element
Title	A name given to the resource	Author or creator	An entity primarily responsible for making the resource	Date	A point in period of time associated with an event in the lifecycle of the resource
Subject	The topic of the resource	Publisher	An entity responsible for making the resource available	Type	The nature or genre of the resource
Description	An account of the resource	Contributor	An entity responsible for making contributions to the resource	Format	The file format, physical medium, or dimensions of the resource
Source	A related resource from which the described resource is derived	Rights	Information about the rights held in and over the resource	Identifier	An unambiguous reference to the resource within a given context
Language	Language of the resource				
Relation	A related source				
Coverage	The spatial or temporal topic of the resource, the spatial applicability of the resource, or the jurisdiction under which the resource is relevant				

Table 3.4 Basic Dublin Core Elements (Taylor, 2003; DCMI (d), 2008)

The following table shows how the elements in Table 3.3 are being represented in the IK database.

Content & about the resource	Represented as the following in an IK database	Intellectual property	Represented as the following in an IK database	Electronic or physical manifestation	Represented as the following in an IK database
Title	title_text in tblIK_data entity	Author or creator	The IK holder stored in tblHolder	Date	All tables in the database has a date attribute
Subject	field_name, field_desc, subfield_name, subfield_desc in tblTaxonomy	Publisher	The data capturer stored in tblFieldWorker_DataCapturer	Type	See Format
Description	Ik_desc in tblIK_data; image_desc in tblImage; multi_desc in tblAudio_Video	Contributor	There are several contributors apart from the two mentioned above: organisation stored in tblOrganisation, field workers stored in tblFieldWorker_DataCapturer, translators and transcribers stored in tblTrans	Format	Two tables namely tblAudio_Video and tblImage stores the multimedia information. The names of the tables indicate the format and thus the type.
Source	Not applicable, see relation	Rights	tblAccess_Level, tblUser_Group_Access and tblPaid_Private_Access store the access and therefore the rights to the IK	Identifier	Keyword_field and keyword_subfield attribute in tblTaxonomy
Language	Lang_id foreign key in tblIK_data and tblTrans (translation); also store the languages of all participants in the database, i.e. IK holders, field workers, data capturer,	*PRA technique*	*The PRA techniques used to collect information is captured in tblPRA_technique*	*Samples Collected*	*Information about physical samples that are collected and stored somewhere is captured in tblSamples_Collected.*

	users, translators, and transcribers				
Relation	Relatedsource_info in tblIK_data				
Coverage	tblLocation records information such as: province, country and co-ordinates, to name a few, and is linked to tblIK_data,tblHolder (IK holder).				
Means of Exchange	*How knowledge is transferred from one IK holder to the next is stored in tblMeans_of_Exchange.*				
Modes of Exchange	*Who holds the IK, is stored in the tblModes_of_Exchange.*				
Context of Exchange	*The context of how the knowledge is shared is stored in tblContext_of_Exchange.*				
Bearer of knowledge	*Information about the knowledge carrier is stored in tbl_Bearer_of_Knowledge.*				

Table 3.5 Dublin Core elements modified to include IK and representations given from the prototype IK database

3.4.3. Types of taxonomies

The term taxonomy has been widely used, to the point that when something is referred to as taxonomy, it can be just about anything. However, it will usually mean some sort of abstract structure. Originally, taxonomies had their beginning as a hierarchical classification system for life forms in the eighteenth century (Garshol, 2004:381). The simplest way to explain taxonomy is the way in which data is organised into categories and subcategories. For instance, fruit (category) can have two subcategories (vine fruits and tree fruit) with (vine fruits - tomatoes, grapes) and (tree fruit - pears, apples) respectively categorised into the subcategories (Cumming, 2004:8). The taxonomy helps users by describing the objects from the point of view of metadata. There is really no difference between a simple controlled vocabulary and taxonomy. Metadata only relates object to subjects, whereas here, the subjects being used for classification is arranged, but it is not itself metadata; taxonomy can be used in metadata (Garshol, 2004:381). An example of how this works is described on the World Bank's website. In Kenya, the Maasai and Barabaig learns the names of the animals and plants, their behavioural patterns, and the ecological factors under which they flourish. The Maasai and Barabaig acquire knowledge about plants and topographical factors that influence their distribution/location are described. An inventory is kept of species, and people keep record of species that disappear. Names are assigned to new plants and animals. The taxonomy reflects the use of plants for medicinal, social, economic, or cultural usefulness or other determining characteristics, as in the case of poisonous plants. Sometimes, biological or ecological features of the species are reflected in the names. This taxonomy of important species is then incorporated into cultural/religious beliefs, taboos, legends, or myths (World Bank 1(c), 2008).

Tavana who wrote a paper on sustainable development in Somoa and the key role that IK play has an interesting way of describing the traditional naming and classification systems called ethnotaxonomy. The doctor states that

“indigenous society’s extensive use of plants to sustain life enabled them to create their own traditional naming and classification systems – ethnotaxonomy. In the summer of 2000, a group of professors and Tropical Ethno botany graduate students from the National Tropical Botanical Garden in Hawaii went on a field expedition to Samoa, studying the naming systems of plants for the first time, and compiled a comprehensive list of breadfruit varieties and names. Using the morphological criteria, about three hundred and fifty Samoans were interviewed to distinguish breadfruit varieties. Results show that the Samoan ethno taxonomy also use both binomial and mononomial nomenclature similar to that used in Western taxonomy” (Tavana, 2001:24). In the field of IK, the metadata schema that will be used in a database can be predetermined, but it will be impossible to determine how users will categorise their knowledge. Therefore in this thesis, the type of taxonomy (taxonomies) used by communities cannot be pre-determined. The community members involved in capturing their knowledge will present their own taxonomies which will then be slotted into the metadata schema. There should however be catered for both the Western taxonomy (which is a set taxonomy when it comes to biological categories for plants and animals) and the ethnotaxonomy as described above by Tavana.

3.5. DATA SECURITY AND LEVELS OF USER ACCESS

A crucial aspect of the database development will be the data security and levels of user access. IP issues may come into play with the data security and user access but because the IP issues have previously been addressed, this part of the discussion will move forward as if IP is not an issue. User access in this instance refers to levels of user access to the database in order to give users access to the database and not to the physical need for, for instance, computers.

When looking at the dissemination of IK, there is primarily two groups: IK protection groups and open-knowledge advocates. IK protection groups

believe that the inclusion of their IK as part of the public domain is an inappropriate and highly damaging strategy of cultural appropriation. Open-knowledge groups advocate the release of information bound by strong IP laws from what are seen as inappropriate constraints and overprotection (Kansa, Schultz & Bissell, 2005:290). The two groups have entirely different aims but must be reconciled in some way, because the groups co-exist and that will not change. There will always be those who feel that IK is sacred and belongs to the community and those who feel "the more the merrier". These two groups will have to be reconciled within the IP arena. What the two groups nevertheless implicate for the security of the data is that each item (IK record) that is entered into the database will have its own access level which is not on the community level, i.e. all of a community's IK is stored under one access level. The levels of user access are to determine who has access to what data. There are three possible access levels;

- Public – the knowledge is available to all users of the IK database.
- Private Group – the knowledge is available only to those who have access to the specific community's knowledge (Different communities will not have access to each other's knowledge therefore each community must have its own security codes. For instance, the first community will be '0001'. They will only have access to private knowledge that is tagged as '0001' knowledge.). Also within the group are levels of access: public (open for all), community (open to all in the community), traditional healer (only for traditional healers), and community leaders (only for community leaders' eyes).
- Private Paid – the knowledge is only available on a paid for basis.

On the topic of the physical security of data, i.e. where servers are stored and so forth, the DST has offered to centralise the databases on their secure servers. All possible IK organisations will have to ensure that their servers are in secure facilities so that the work being done cannot be compromised by theft or natural elements like wind, fire, or water.

3.6. THE RELATIONSHIPS BETWEEN DIFFERENT ENTITIES

The entity-relationship diagram (ER diagram) or the CDM will help to identify which entities have relationships with one another as well as what the nature of the relationship is. The CDM report will be included in Chapter 4. An entity can be described as something about which data is to be stored, for instance, a person, place, or concept. A relationship describes how the entities interact with each other. The following discussion is a short overview of the entities (see Figure 4.1).

The *tblUser* entity relates to the users of the database and does not refer to the IK holders. If IK holders would like to use the database, they will also have to register as users of the system. The process to become a user will involve registering by completing a registration form that will be checked by the organisation responsible for the database in order to determine the user's access level. The users cannot become members of the system without a security check. The user entity links to the *tblPersonal_Info* entity that captures the personal information of the user. The *tblAccess_level* entity will have the different access levels that are available on the system. The security concerns of the data so far have shown that there will be three levels. Information will be either public and freely available (public), or locked for outsiders i.e. users that are not part of the IK holder group (private group). This means that the holders do not want to share the knowledge with everyone and special access must be granted for a user to access the group's knowledge. The third level is a "paid for knowledge" level, which will involve a payment for the knowledge option (private paid). The IK holders can elect to share certain knowledge but feel that it should be paid for. The *tblUser_Group_Acces*s entity stores information on which user has access to what group's knowledge (as discussed in section 3.5). The *tblPaid_Private_Access* entity has the information on which user has paid for what IK records.

The next entity is tbl*IK_Data* entity. This entity has the date, title, description, related sources information, IP code, IP description, and known-since date (indicating since when the information was known to the IK holder). The relationship to other entities within the database is:

- *tblHolder* - IK holder information, links to *tblPersonal_Info* – this entity collects the personal information about the IK holder;
- *tblFieldWorker_DataCapturer* - field worker who gathered knowledge and data capturers who entered the knowledge into the database, links to *tblPersonal_Info* – this entity collects the personal information about the field worker and data capturers;
- *tblLanguage* - language in which knowledge is captured;
- *tblPRA_technique* - PRA techniques used, refer to Chapter 2;
- *tblValidation* - validation of the knowledge;
- *tblLocation* - location of knowledge because it is not to say that the IK holder location and knowledge location is the same;
- *tblSamples_Collected* - information about physical samples collected, such as where they are being stored;
- *tblBearer_of_Knowledge* - bearers of knowledge - men, women, elders, youth, the elderly, etc.;
- *tblMode_of_Exchange* - who transfers the knowledge? - from parent to child, story tellers, trainer to apprentice;
- *tblMeans_of_Exchange* - how is knowledge transferred? - oral, practical implementation, songs;
- *tblContext_of_Exchange* - in what context is the knowledge exchanged? - hierarchy, competition, or by reputation;
- *tblOther_Name* - synonyms, foreign names, and mother tongue names;
- *tblOrganisation* - organisation involved in gathering this knowledge; and
- *tblTaxonomy* – of what field is this knowledge part, see 3.4.3.

The purpose of these entities can be gathered from the discussion above and will therefore not be elaborated on further.

The next entities to be discussed are referred to as the multimedia entities. These entities hold the multimedia information for the IK gathered, for instance audio files, video files and images, photos, and sketches. The entities are *tblImage* and *tblAudio_Video*. The question is whether all the information gathered (raw data) should be entered into the database and be made available, specifically the audio and video files, or whether an already refined version of the gathered data should be added? For instance, the IK holder is asked how seeds are dried and this monologue is recorded. The steps needed to dry the seeds are what is required, which can be about two to three minutes worth of audio/video, but the IK holder takes twenty five minutes to complete his/her trail of thought. Is it better to include the entire recording or just the steps for drying seeds? The problem is that if the knowledge stored is not monitored carefully to ensure that only the necessary knowledge is entered into the database, there will be a lot of unused data in the database. The question to be asked is: Is this efficient? The storage capacity that is available today has improved dramatically, but it should still not be considered as inexhaustible, because the more information added to the database, the more information will have to be searched and managed. If the knowledge is downloaded over the World Wide Web, the low bandwidth available in South Africa and the high volume of data can have a negative impact. Therefore, the best solution might be for the IK team working on the data to determine the knowledge that has to be stored on a needs basis. An extra entity, called *tblOrg_Audio_Video* have been created to store the original files (unedited) if such a facility is required. If, however, the oral history of an IK holder is being recorded, it changes the picture, because then it will be necessary to save all the information. The entities *tblTranscription* and *tblTranslation* hold the transcriptions of the audio or video recordings, and translations of these transcriptions will be placed in the translation table. The transcription and translation of information will not be done as a rule but based on the need. For instance, if a Sesotho tribe discloses their method for slaughtering cattle, it will be recorded in Sesotho, their mother tongue.

Although it is an official South African language, it is spoken only in certain regions of the country. Therefore it could be required that the knowledge be transcribed first and then translated into English, because if the knowledge is shared with other users (not only Sesotho speakers), they will not be able to understand the knowledge unless it is translated. The knowledge cannot be translated directly from the audio or video file. It has to be transcribed i.e. made text and then translated. There is also an entity called *tblTrans* to collect the information of the translators and transcribers that links to *tblPersonal_Info* to collect their personal information.

Lastly, an entity called *tblGroup* which is linked to the IK holder entity is discussed. This entity will hold information such as what tribes or villages are involved in the projects. The IK holder will have to be part of a group registered on the system. The group entity is also used to help determine access levels of users for the private group level. The CDM report in Chapter 4 will elaborate more on the entities, attributes, and relationships of the IK database.

CHAPTER 4

Prototype design of an IK database (Practical)

4.1. INTRODUCTION

As discussed in Chapter 3, the conceptual design stage uses data modelling to create an abstract database structure that represents real-world objects in the most authentic way possible. The conceptual model has to embody a clear understanding of the business and its functional areas. The next phase is the design of the database which, as stated previously, is taking place by using platform independent software. The software is called PowerDesigner Data Architect version 6.

In this chapter, the focus will be on the conceptual design of the IK database and the layout of the table schema. A possible elementary prototype Graphical User Interface (GUI) will be depicted in order to show the database's three main functions: adding new members, adding new IK record, and searching the IK database.

4.2. CONCEPTUAL DATA MODEL OF THE IK DATABASE

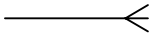
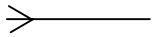
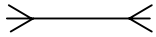
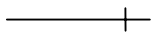
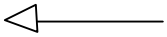
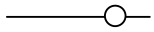
This section is the standard Conceptual Data Model (CDM) report created by PowerDesigner. The report has been edited to show only relevant information. The prototype IK database is represented in this report in its totality with descriptions of the entities, attributes, and relationships, showing what their uses are and can be.

CDM GRAPHS

Global Model Graph

The underlying model is a graphical representation of the CDM. An in-depth description of the entities, attributes, and relationships being represented in the data model will follow.

The following symbol list is used in the graphical representation to illustrate relationships and roles between the different entities.

Symbol	Function Representation
	One to one
	One to many
	Many to one
	Many to many
	Mandatory role
	Dependent role
	Optional role

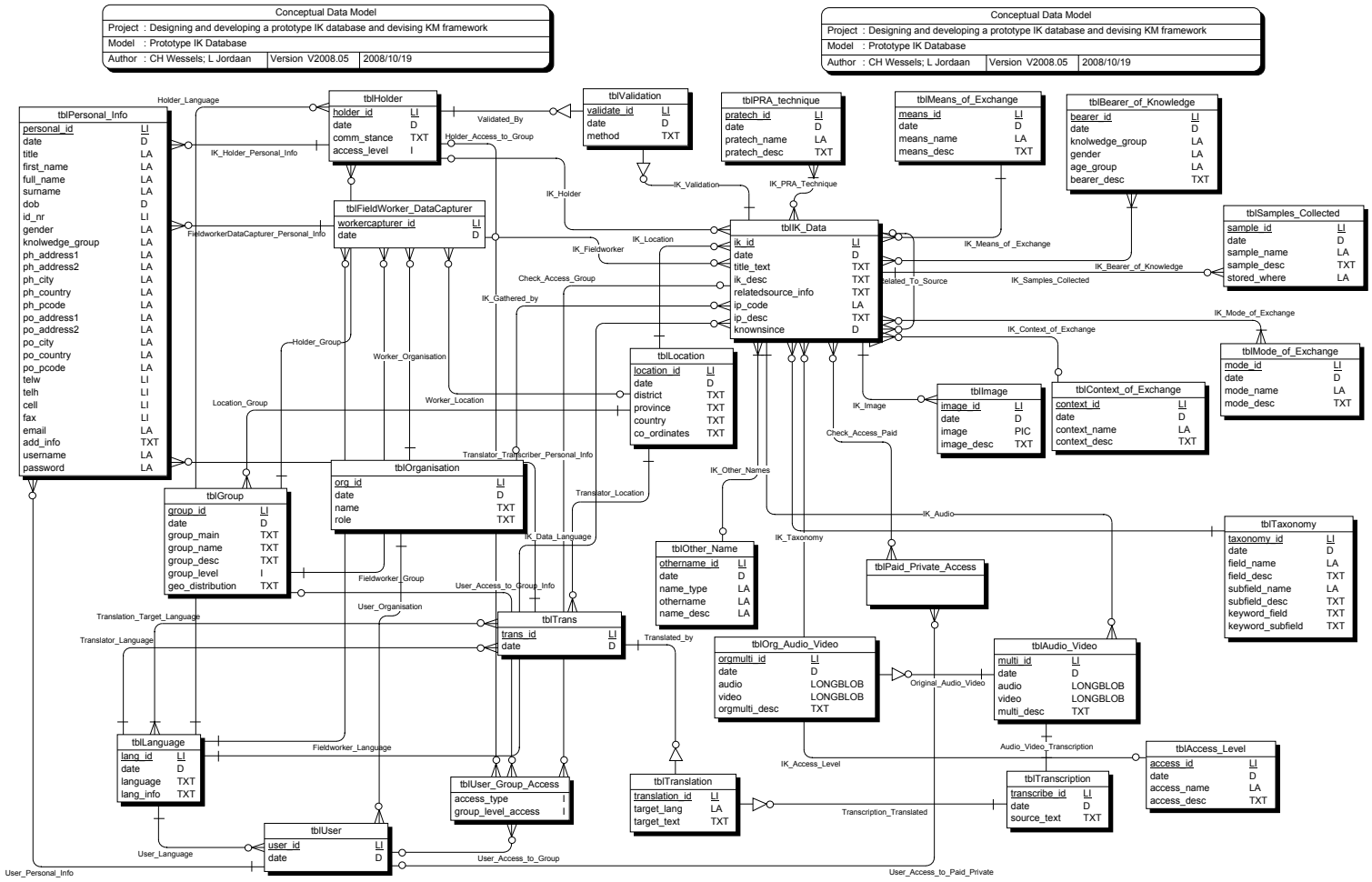


Figure 4.1 Conceptual Data Model

LISTS OF OBJECTS

TXT = Text
LA = Long Character
D = Date
LI = Long Integer
PIC = Image files
I = Integer
LONGBLOB = Audio/Video Files

Name	Type
access_desc	TXT
access_id	LI
access_level	I
access_name	LA
access_type	I
add_info	TXT
age_group	LA
audio	LONGBLOB
bearer_desc	TXT
bearer_id	LI
by_whom	LA
cell	LI
co_ordinates	TXT
comm_stance	TXT
context_desc	TXT
context_id	LI
context_name	LA
country	TXT
date	D
district	TXT
dob	D
email	LA
ethnic_group	LA
fax	LI
field_desc	TXT
field_name	LA
first_name	LA
full_name	LA
gender	LA
geo_distribution	TXT
group_desc	TXT
group_id	LI
group_level	I

Name	Type
group_level_access	I
holder_id	LI
id_nr	LI
ik_desc	TXT
ik_id	LI
image	PIC
image_desc	TXT
image_id	LI
ip_code	LA
ip_desc	TXT
keyword_field	TXT
keyword_subfield	TXT
keyword_topic	TXT
knowledge _group	LA
knownsince	D
lang_id	LI
lang_info	TXT
language	TXT
location_id	LI
marital_status	LA
means_desc	TXT
means_id	LI
means_name	LA
method	TXT
mode_desc	TXT
mode_id	LI
mode_name	LA
multi_desc	TXT
multi_id	LI
name	TXT
name_desc	LA
name_type	LA
org_id	LI
orgmulti_desc	TXT
orgmulti_id	LI
othername	LA
othername_id	LI

Name	Type
password	LA
personal_id	LI
ph_address1	LA
ph_address2	LA
ph_city	LA
ph_country	LA
ph_pcode	LA
po_address1	LA
po_address2	LA
po_city	LA
po_country	LA
po_pcode	LA
pratech_desc	TXT
pratech_id	LI
pratech_name	LA
province	TXT
relatedsource_info	TXT
role	TXT
sample_desc	TXT
sample_id	LI
sample_name	LA
source_text	TXT
stored_where	LA
subfield_desc	TXT
subfield_name	LA
surname	LA
target_lang	LA
target_text	TXT
taxonomy_id	LI
telh	LI
telw	LI
title	LA
title_text	TXT
topic_desc	TXT
topic_name	LA
trans_id	LI
transcribe_id	LI

Name	Type
translation_id	LI
user_id	LI
username	LA
validate_id	LI
video	LONGBLOB
workercapturer_id	LI

Entity List

Name
tblAccess_Level
tblAudio_Video
tblBearer_of_Knowledge
tblContext_of_Exchange
tblFieldWorker_DataCapturer
tblGroup
tblHolder
tblIK_Data
tblImage
tblLanguage
tblLocation
tblMeans_of_Exchange
tblMode_of_Exchange
tblOrg_Audio_Video
tblOrganisation
tblOther_Name
tblPaid_Private_Access
tblPersonal_Info
tblPRA_technique
tblSamples_Collected
tblTaxonomy
tblTrans
tblTranscription
tblTranslation
tblUser
tblUser_Group_Access
tblValidation

Relationship List

Name
Audio_Video_Transcription
Check_Access_Group
Check_Access_Paid
Fieldworker_Group
Fieldworker_Language
FieldworkerDataCapturer_Personal_Info
Holder_Access_to_Group
Holder_Group
Holder_Language
IK_Access_Level
IK_Audio
IK_Bearer_of_Knowledge
IK_Context_of_Exchange
IK_Data_Language
IK_Fieldworker
IK_Fieldworker
IK_Gathered_by
IK_Holder
IK_Holder_Personal_Info
IK_Image
IK_Location
IK_Means_of _Exchange
IK_Mode_of_Exchange
IK_Other_Names
IK_PRA_Technique
IK_Samples_Collected
IK_Taxonomy
IK_Validation
Location_Group
Original_Audio_Video
Related_To_Source
Transcription_Translated
Translated_by
Translation_Target_Language
Translator_Language
Translator_Location

Name
Translator_Transcriber_Personal_Info
User_Access_to_Group
User_Access_to_Group_Info
User_Access_to_Paid_Private
User_Language
User_Organisation
User_Personal_Info
Validated_By
Worker_Location
Worker_Organisation

ENTITY INFORMATION

4.1. Entity: tblAccess_Level

Name:	tblAccess_Level
Generate Table:	Yes

The tblAccess_Level entity stores the security levels for the IK in the database. There are three possible access levels: Public - the knowledge is available to all users of the IK database; Private Group - the knowledge is available only to those who have access to the specific community's knowledge; Private Paid - the knowledge is only available on a paid for basis.

Attribute List

I =Identifier M = Value for the attribute is Mandatory

Name	Type	I	M
access_id	LI	Yes	Yes
date	D	No	No
access_name	LA	No	No
access_desc	TXT	No	No

Data Item: access_id

Primary Key of the tblAccess_Level entity.

Data Item: date

Date on which information was added to the system.

Data Item: access_name

The access_name attribute stores the name of the access level: Public, Public Group, and Private Paid.

Data Item: access_desc

The access_desc attribute describes each access level available.

Reference List

Card = Cardinality of relationship Dep. = Dependency

Entity	Card	Dep.	Relationship
tblIK_Data	0,n	No	IK_Access_Level

4.2. Entity: tblAudio_Video

Name:	tblAudio_Video
Generate Table:	Yes

The tbl_Audio_Video entity stores edited audio and video files. These files have been edited, but the originals (if they are kept) can be found in the tblOrg_Audio_Video entity.

Attribute List

Name	Type	I	M
multi_id	LI	Yes	Yes
date	D	No	No
audio	LONGBLOB	No	No
video	LONGBLOB	No	No
multi_desc	TXT	No	No

Data Item: multi_id

Primary Key of the tblAudio_video entity.

Data Item: date

Date on which information was added to the system.

Data Item: audio

The audio attribute stores the audio files.

Data Item: video

The video attribute stores the video files.

Data Item: multi_desc

The multi_desc attribute stores a description of the audio or video file.

Reference List

Entity	Card	Dep.	Relationship
tblTranscription	1,1	No	Audio_Video_Transcription
tblIK_Data	1,1	No	IK_Audio
tblOrg_Audio_Video	0,1	Yes	Original_Audio_Video

4.3. Entity: tblBearer_of_Knowledge

Name:	tblBearer_of_Knowledge
Generate Table:	Yes

The entity tblBearer_of_Knowledge stores information about the knowledge carrier. It entails knowledge like: Are the knowledge held by men, women, or both? Is the knowledge held by younger or older people in the community? Is the knowledge held by farmers in the community?

Attribute List

Name	Type	I	M
bearer_id	LI	Yes	Yes
date	D	No	No
knowledge_group	LA	No	No
gender	LA	No	No
age_group	LA	No	No
bearer_desc	TXT	No	No

Data Item: bearer_id

Primary Key of the tblBearer_of_Knowledge entity.

Data Item: date

Date on which information was added to the system.

Data Item: knowledge_group

The attribute holds the group that traditionally knows the knowledge, for instance: farmers, traditional healers, bead workers, etc.

Data Item: gender

The gender attribute holds the gender of the IK holder, field worker, data capturer, translator, transcriber and user; it has only two possible

values, male or female.

Data Item: age_group

The age_group attribute stores information about the age of the group that generally carries the specific knowledge.

Data Item: bearer_desc

The bearer_desc attribute allows the storage of information that needs to be known about this specific bearer.

Reference List

Entity	Card	Dep.	Relationship
tblIK_Data	0,n	No	IK_Bearer_of_Knowledge

4.4. Entity: tblContext_of_Exchange

Name:	tblContext_of_Exchange
Generate Table:	Yes

The entity tblContext_of_Exchange stores information about the context of how the knowledge is shared. For instance, the knowledge can be shared in a hierarchy, by reputation, expertise, parity, authority, or competition.

Attribute List

Name	Type	I	M
context_id	LI	Yes	Yes
date	D	No	No
context_name	LA	No	No
context_desc	TXT	No	No

Data Item: context_id

Primary Key of the tblContext_of_Exchange entity.

Data Item: date

Date on which information was added to the system.

Data Item: context_name

The context_name attribute stores the name of the context of exchange.

Data Item: context_desc

The context_desc attribute stores a description about the context of exchange.

Reference List

Entity	Card	Dep.	Relationship
tblIK_Data	0,n	No	IK_Context_of_Exchange

4.5. Entity: tblFieldWorker_DataCapturer

Name:	tblFieldWorker_DataCapturer
Generate Table:	Yes

The tblFieldWorker_DataCapturer entity stores information about the field workers and data capturers. This includes their personal details, location, language, group (community), and the organisation to which they belong.

Attribute List

Name	Type	I	M
workercapturer_id	LI	Yes	Yes
date	D	No	No

Data Item: workercapturer_id

Primary Key of the tblFieldWorker_DataCapturer entity.

Data Item: date

Date on which information was added to the system.

Reference List

Entity	Card	Dep.	Relationship
tblGroup	1,1	No	Fieldworker_Group
tblLanguage	1,1	No	Fieldworker_Language
tblPersonal_Info	0,n	No	FieldworkerDataCapturer_Personal_Info
tblIK_Data	0,n	No	IK_Fieldworker
tblLocation	0,1	No	Worker_Location
tblOrganisation	1,1	No	Worker_Organisation

4.6. Entity: tblGroup

Name:	tblGroup
Generate Table:	Yes

The tblGroup entity stores information about the community to which the IK holder and the field worker belongs. It stores the community name, a description about the community, and the geographical distribution of the main group to which they belong. It also stores group levels that will help with access level checks of knowledge.

Attribute List

Name	Type	I	M	
group_id	LI	Yes	Yes	
date	D	No	No	
group_main	TXT	No	No	
group_name	TXT	No	No	
group_desc	TXT	No	No	
group_level	I	No	No	
geo_distribution	TXT	No	No	

Data Item: group_id

Primary Key of the tblGroup entity.

Data Item: date

Date on which information was added to the system.

Data Item: group_main

The group_main attribute stores the main group to which the

community belongs, for instance Zulu, Xhosa, Tswana.

Data Item: group_name

The group_name attribute refers to the name by which the community is known.

Data Item: group_desc

The group_desc attribute is a description about the group.

Data Item: group_level

Within the group (community), there are four levels for information classification: public, general (for whole community), traditional healers (only the traditional healers), and community leaders. This is to help with the classification and security of the knowledge.

Data Item: geo_distribution

The geo_distribution attribute is the way in which the main group to which the community belongs is distributed across the country. For instance, it is well known that the Zulu group is primarily situated in the Kwazulu-Natal province, but there is a possibility that a Zulu community may be situated in the Free State or Mpumalanga which are the neighbouring provinces.

Reference List

Entity	Card	Dep.	Relationship
tblFieldWorker_DataCapturer	0,n	No	Fieldworker_Group
tblHolder	0,n	No	Holder_Group
tblLocation	1,1	No	Location_Group
tblUser_Group_Access	0,n	No	User_Access_to_Group_Info

4.7. Entity: tblHolder

Name:	tblHolder
Generate Table:	Yes

The tblHolder entity stores information about the IK Holder. It includes their personal details, location, language, and the group (community) to which they belong.

Attribute List

Name	Type	I	M
holder_id	LI	Yes	Yes
date	D	No	No
comm_stance	TXT	No	No
access_level	I	No	No

Data Item: holder_id

Primary Key of the tblHolder entity.

Data Item: date

Date on which information was added to the system.

Data Item: comm_stance

The comm_stance attribute stores the IK holder's rank within the community. For instance, is it a community leader, traditional healer, etc.

Data Item: access_level

The access_level attribute indicates the level of access that a user has.

Reference List

Entity	Card	Dep.	Relationship
tblGroup	0,n	No	Holder_Access_to_Group
tblGroup	1,1	No	Holder_Group
tblLanguage	1,1	No	Holder_Language
tblIK_Data	0,n	No	IK_Holder
tblPersonal_Info	0,n	No	IK_Holder_Personal_Info
tblValidation	0,n	Yes	Validated_By

4.8. Entity: tblIK_Data

Name:	tblIK_Data
Generate Table:	Yes

The IK_Data entity can be seen as the main IK entity in the database. The first step when adding or searching for information will start here. It holds information such as the title, description of the information, since when the information was known to the IK holder or community, and whether there are already other resources in the database related to the IK record being added.

Attribute List

Name	Type	I	M
ik_id	LI	Yes	Yes
date	D	No	No
title_text	TXT	No	No
ik_desc	TXT	No	No
relatedsource_info	TXT	No	No
ip_code	LA	No	No
ip_desc	TXT	No	No
knownsince	D	No	No

Data Item: ik_id

Primary Key of the tblIK_Data entity.

Data Item: date

Date on which information was added to the system.

Data Item: title_text

The title_info attribute stores the overall name of the IK record that is being added.

Data Item: ik_desc

The ik_desc attribute stores a description of the IK record that is being stored.

Data Item: relatedsource_info

The relatedsource_info attribute indicates whether the IK record being added has a link to another resource that is already part of the

database or a related source.

Data Item: ip_code

The ip_code attribute stores the Intellectual Property (IP) code of the IK record, if it has already been registered.

Data Item: ip_desc

The ip_desc stores information on the stance of the IP registration process or if it is the intention not to register the knowledge.

Data Item: knownsince

The knownsince attribute stores a date indicating since when the information has been known to the IK holder or community.

Reference List

Entity	Card	Dep.	Relationship
tblUser_Group_Access	0,n	No	Check_Access_Group
tblPaid_Private_Access	0,n	No	Check_Access_Paid
tblAccess_Level	0,1	No	IK_Access_Level
tblAudio_Video	0,n	No	IK_Audio
		No	IK_Bearer_of_Knowledge
tblContext_of_Exchange	0,1	No	IK_Context_of_Exchange
tblLanguage	1,1	No	IK_Data_Language
tblFieldWorker_DataCapturer	0,1	No	IK_Fieldworker
tblPersonal_Info	0,1	No	IK_Fieldworker
tblOrganisation	0,1	No	IK_Gathered_by
tblHolder	0,1	No	IK_Holder
tblImage	0,n	No	IK_Image
tblLocation	1,1	No	IK_Location
tblMeans_of_Exchange	1,1	No	IK_Means_of _Exchange
tblMode_of_Exchange	1,n	No	IK_Mode_of_Exchange
tblOther_Name	0,1	No	IK_Other_Names
tblPRA_technique	1,n	No	IK_PRA_Technique
tblSamples_Collected	0,n	No	IK_Samples_Collected
tblTaxonomy	1,1	No	IK_Taxonomy
tblValidation	0,n	Yes	IK_Validation
tblIK_Data	0,1	No	Related_To_Source

4.9. Entity: tblImage

Name:	tblImage
Generate Table:	Yes

The tblImage entity stores image files like photographs and drawings.

Attribute List

Name	Type	I	M
image_id	LI	Yes	Yes
date	D	No	No
image	PIC	No	No
image_desc	TXT	No	No

Data Item: image_id

Primary Key of the tblImage entity.

Data Item: date

Date on which information was added to the system.

Data Item: image

The image attribute stores image files like photographs and drawings.

Data Item: image_desc

The image_desc attribute allows the description of the image or drawing to be added.

Reference List

Entity	Card	Dep.	Relationship
tblIK_Data	1,1	No	IK_Image

4.10. Entity: tblLanguage

Name:	tblLanguage
Generate Table:	Yes

The tblLanguage entity stores information about the languages that will be used within the database. It is either the home language of people (IK holder, field worker, data capturer, user) or a language that has been used as the

target language for a translation.

Attribute List

Name	Type	I	M
lang_id	LI	Yes	Yes
date	D	No	No
language	TXT	No	No
lang_info	TXT	No	No

Data Item: lang_id

Primary Key of the tblLanguage entity.

Data Item: date

Date on which information was added to the system.

Data Item: language

The language attribute stores the name of the language.

Data Item: lang_info

The lang_info stores information that should be or is known about the language.

Reference List

Entity	Card	Dep.	Relationship
tblFieldWorker_DataCapturer	0,n	No	Fieldworker_Language
tblHolder	0,n	No	Holder_Language
tblIK_Data	0,n	No	IK_Data_Language
tblTrans	0,n	No	Translation_Target_Language
tblTrans	0,n	No	Translator_Language
tblUser	0,n	No	User_Language

4.11. Entity: tblLocation

Name:	tblLocation
Generate Table:	Yes

The tblLocation entity stores the location where the information/person that has been added to the database can be found.

Attribute List

Name	Type	I	M
location_id	LI	Yes	Yes
date	D	No	No
district	TXT	No	No
province	TXT	No	No
country	TXT	No	No
co_ordinates	TXT	No	No

Data Item: location_id

Primary Key of the tblLocation entity.

Data Item: date

Date on which information was added to the system.

Data Item: district

The district attribute stores the district within a province in which the information/person can be found.

Data Item: province

The province attribute stores the province within the country in which the information/person can be found.

Data Item: country

The country attribute stores the country in which the information/person can be found.

Data Item: co_ordinates

The co_ordinates attributes refers to GPS co-ordinates that can be added to the system in order to pinpoint the exaction location.

Reference List

Entity	Card	Dep.	Relationship
tblIK_Data	0,n	No	IK_Location
tblTrans	0,n	No	Translator_Location
tblFieldWorker_DataCapturer	0,n	No	Worker_Location

4.12. Entity: tblMeans_of_Exchange

Name:	tblMeans_of_Exchange
Generate Table:	Yes

The tblMeans_of_Exchange entity stores information on how knowledge is transferred from one IK holder to the next. For example, is the knowledge transferred orally, with songs, with practical implementation, or with sketches and plays?

Attribute List

Name	Type	I	M
means_id	LI	Yes	Yes
date	D	No	No
means_name	LA	No	No
means_desc	TXT	No	No

Data Item: means_id

Primary Key of the tblMeans_of_Exchange entity.

Data Item: date

Date on which information was added to the system.

Data Item: means_name

The mean_name attribute stores the name of the means of exchange.

Data Item: means_desc

The means_desc attribute stores a description about the means of exchange.

Reference List

Entity	Card	Dep.	Relationship
tblIK_Data	0,n	No	IK_Means_of _Exchange

4.13. Entity: tblMode_of_Exchange

Name:	tblMode_of_Exchange
Generate Table:	Yes

The tblMode_of_Exchange entity stores information on who holds the IK. For example, is the knowledge transferred from parents to children, trainer to apprentice, or by storytellers, informal groups, spiritual leaders, or perhaps through migration?

Attribute List

Name	Type	I	M
mode_id	LI	Yes	Yes
date	D	No	No
mode_name	LA	No	No
mode_desc	TXT	No	No

Data Item: mode_id

Primary Key of the tblMode_of_Exchange entity.

Data Item: date

Date on which information was added to the system.

Data Item: mode_name

The mode_name attribute stores the name of the mode of exchange.

Data Item: mode_desc

The mode_desc attribute stores a description about the mode of exchange.

Reference List

Entity	Card	Dep.	Relationship
tblIK_Data	0,n	No	IK_Mode_of_Exchange

4.14. Entity: tblOrg_Audio_Video

Name:	tblOrg_Audio_Video
Generate Table:	Yes

The tblOrg_Audio_Video entity stores audio and video files that the researcher(s) want to keep. These files have not been edited in any way.

Attribute List

Name	Type	I	M
orgmulti_id	LI	Yes	Yes
date	D	No	No
audio	LONGBLOB	No	No
video	LONGBLOB	No	No
orgmulti_desc	TXT	No	No

Data Item: orgmulti_id

Primary Key of the tblOrg_Audio_Video entity.

Data Item: date

Date on which information was added to the system.

Data Item: audio

The audio attribute stores the audio files.

Data Item: video

The video attribute stores the video files.

Data Item: orgmulti_desc

The orgmulti_desc attribute stores a description of the original audio or video files.

Reference List

Entity	Card	Dep.	Relationship
tblAudio_Video	1,1	Yes	Original_Audio_Video

4.15. Entity: tblOrganisation

Name:	tblOrganisation
Generate Table:	Yes

The tblOrganisation entity allows for the storage of organisations that are involved in the project in one way or another. The purpose is to store their role in the project and also see which organisations do what.

Attribute List

Name	Type	I	M
org_id	LI	Yes	Yes
date	D	No	No
name	TXT	No	No
role	TXT	No	No

Data Item: org_id

Primary Key of the tblOrganisation entity.

Data Item: date

Date on which information was added to the system.

Data Item: name

The name attribute stores the name of the organisation that is involved in the project. For instance, it can refer to a university that is hosting a IK centre or doing research in the field and using the database to store information.

Data Item: role

The role attribute store the role that they play in the overall project. The organisation can be involved in field work, data capturing, or research.

Reference List

Entity	Card	Dep.	Relationship
tblIK_Data	0,n	No	IK_Gathered_by
tblUser	0,n	No	User_Organisation
tblFieldWorker_DataCapturer	0,n	No	Worker_Organisation

4.16. Entity: tblOther_Name

Name:	tblOther_Name
Generate Table:	Yes

The tblOther_Name entity stores other names that might exist for the IK record, for instance synonyms, foreign names, and home language names.

Attribute List

Name	Type	I	M
othername_id	LI	Yes	Yes
date	D	No	No
name_type	LA	No	No
othername	LA	No	No
name_desc	LA	No	No

Data Item: othername_id

Primary Key of the tblOther_Name entity.

Data Item: date

Date on which information was added to the system.

Data Item: name_type

The name_type attribute indicates other name types that can exist for the IK record, for instance synonyms, foreign names, and home language names.

Data Item: othername

The othername attribute stores the other name by which the IK item is known.

Data Item: name_desc

The name_desc attribute stores a description about the other name. For instance, it includes where it comes form, why the name exists, where it is used, etc.

Reference List

Entity	Card	Dep.	Relationship
tblIK_Data	1,n	No	IK_Other_Names

4.17. Entity: tblPaid_Private_Access

Name:	tblPaid_Private_Access
Generate Table:	Yes

The tblPaid_Private_Access entity holds information on users that have paid to see certain knowledge. The paid-for information is not the group's entire

body of knowledge, but only certain IK records. The entity is a bridge entity between tblIK_Data and tblUser. For instance, the user code 0001 has paid for access to IK data code 0090. If these code are in the paid-for table, the user will get access.

Reference List

Entity	Card	Dep.	Relationship
tblIK_Data	0,n	No	Check_Access_Paid
tblUser	0,1	No	User_Access_to_Paid_Private

4.18. Entity: tblPersonal_Info

Name:	tblPersonal_Info
Generate Table:	Yes

The tblPersonal_Info entity stores information about the people involved in the database such as personal information about field workers, data capturers, users, IK holders, translators, and transcribers.

Attribute List

Name	Type	I	M
personal_id	LI	Yes	Yes
date	D	No	No
title	LA	No	No
first_name	LA	No	No
full_name	LA	No	No
surname	LA	No	No
dob	D	No	No
id_nr	LI	No	No
gender	LA	No	No
ethnic_group	LA	No	No
ph_address1	LA	No	No
ph_address2	LA	No	No
ph_city	LA	No	No
ph_country	LA	No	No
ph_pcode	LA	No	No

Name	Type	I	M
po_address1	LA	No	No
po_address2	LA	No	No
po_city	LA	No	No
po_country	LA	No	No
po_pcode	LA	No	No
telw	LI	No	No
telh	LI	No	No
cell	LI	No	No
fax	LI	No	No
email	LA	No	No
add_info	TXT	No	No
username	LA	No	No
password	LA	No	No

Data Item: personal_id

Primary Key of the tblFieldWorker_DataCapturer entity.

Data Item: date

Date on which information was added to the system.

Data Item: title

The title attribute captures the title of the IK holder, field worker, data capturer, translator, transcriber, and user, e.g. Mr, Miss, Mrs, etc.

Data Item: first_name

The first_name attribute holds the first name (name by which they are generally called) of the IK holder, field worker, data capturer, translator, transcriber, and user.

Data Item: full_name

The full_name attribute captures the full names of the IK holder, field worker, data capturer, translator, transcriber, and user.

Data Item: surname

The surname attribute holds the surname of the IK holder, field worker, data capturer, translator, transcriber, and user.

Data Item: dob

The dob attribute stores the date of birth of the IK holder, field worker, data capturer, translator, transcriber, and user.

Data Item: id_nr

The id_nr attribute stores the unique identification number that is allocated to every person in a country.

Data Item: gender

The gender attribute holds the gender of the IK holder, field worker, data capturer, translator, transcriber, and user; it has only two possible values, i.e. male or female.

Data Item: ethnic_group

The ethnic_group attribute store the ethnic group to which the IK holder, field worker, data capturer, translator, transcriber, and user belongs.

Data Item: ph_address1

The ph_address1 attribute stores the first line of the physical address of the IK holder, field worker, data capturer, translator, transcriber, and user.

Data Item: ph_address2

The ph_address2 attribute store the second line of the physical address of the IK holder, field worker, data capturer, translator, transcriber, and user.

Data Item: ph_city

The ph_city attribute holds the city/town/community in which the IK holder, field worker, data capturer, translator, transcriber, and user lives.

Data Item: ph_country

The ph_country attribute stores the country in which the IK holder, field worker, data capturer, translator, transcriber, and user finds him or -herself.

Data Item: ph_pcode

The ph_code attribute stores the physical postal code of the address.

Data Item: po_address1

The po_address1 attribute stores the first line of the postal address of the IK holder, field worker, data capturer, translator, transcriber, and user.

Data Item: po_address2

The po_address2 attribute stores the second line of the postal address of the IK holder, field worker, data capturer, translator, transcriber, and user.

Data Item: po_city

The po_city attribute holds the city/town/community of the postal address.

Data Item: po_country

The po_country attribute stores the country of the postal address.

Data Item: po_pcode

The po_code attribute stores the postal code of the postal address.

Data Item: telw

The telw attribute stores the work telephone number of the IK holder, field worker, data capturer, translator, transcriber, and user, if one exists.

Data Item: telh

The telh attribute stores the home telephone number of the IK holder, field worker, data capturer, translator, transcriber, and user, if one exists.

Data Item: cell

The cell attribute stores the cell phone number of the IK holder, field worker, data capturer, translator, transcriber, and user, if one exists.

Data Item: fax

The fax attribute stores the fax telephone number of the IK Holder, field worker, data capturer, translator, transcriber, and user, if one exists.

Data Item: email

The email attribute stores the email address of the IK holder, field worker, data capturer, translator, transcriber, and user, if one exists.

Data Item: add_info

The add_info attribute is an extra storage field to allow for any extra information about the person that might need to be known, for instance if the person has a disability.

Data Item: username

The username attribute stores the user name that has to be used to log into the database. This name has to be unique.

Data Item: password

The password attribute is used in conjunction with the username attribute to ensure a secure log-in for all users of the system.

Reference List

Entity	Card	Dep.	Relationship
tblFieldWorker_DataCapturer	1,1	No	FieldworkerDataCapturer_Personal_Info
tblIK_Data	0,n	No	IK_Fieldworker
tblHolder	1,1	No	IK_Holder_Personal_Info
tblTrans	1,1	No	Translator_Transcriber_Personal_Info
tblUser	1,1	No	User_Personal_Info

4.19. Entity: tblPRA_technique

Name:	tblPRA_technique
Generate Table:	Yes

The tblPRA_techinique is used to store information about the way in which knowledge has been gathered. There are a few techniques that can be used. See Addendum 3.

Attribute List

Name	Type	I	M
pratech_id	LI	Yes	Yes
date	D	No	No
pratech_name	LA	No	No
pratech_desc	TXT	No	No

Data Item: pratech_id

Primary Key of the tblPRA_technique entity.

Data Item: date

Date on which information was added to the system.

Data Item: pratech_name

The pratech_name attribute stores the name of the technique.

Data Item: pratech_desc

The pratech_name attribute stores a description about the technique.

Reference List

Entity	Card	Dep.	Relationship
tblIK_Data	0,n	No	IK_PRA_Technique

4.20. Entity: tblSamples_Collected

Name:	tblSamples_Collected
Generate Table:	Yes

The tblSamples_Collected entity stores information about where samples that have been gathered in the field are located, in other words, where it is stored for safe keeping.

Attribute List

Name	Type	I	M
sample_id	LI	Yes	Yes
date	D	No	No
sample_name	LA	No	No
sample_desc	TXT	No	No
stored_where	LA	No	No

Data Item: sample_id

Primary Key of the tblSamples_Collected entity.

Data Item: date

Date on which information was added to the system.

Data Item: sample_name

The sample_name attributes stores the name that has been given to the collected sample.

Data Item: sample_desc

The sample_desc attribute stores a description of the collected sample.

Data Item: stored_where

The stored_where attribute stores information about where the collected sample is being kept.

Reference List

Entity	Card	Dep.	Relationship
tblIK_Data	1,1	No	IK_Samples_Collected

4.21. Entity: tblTaxonomy

Name:	tblTaxonomy
Generate Table:	Yes

The tblTaxonomy entity holds the taxonomy structure for the IK data.

Attribute List

Name	Type	I	M
taxonomy_id	LI	Yes	Yes
date	D	No	No
field_name	LA	No	No
field_desc	TXT	No	No
subfield_name	LA	No	No
subfield_desc	TXT	No	No
keyword_field	TXT	No	No
keyword_subfield	TXT	No	No

Data Item: taxonomy_id

Primary Key of the tblTaxonomy entity.

Data Item: date

Date on which information was added to the system.

Data Item: field_name

The field_name attribute is the name for the first or main level in the taxonomy.

Data Item: field_desc

The field_desc attribute is the description of the first or main level within the taxonomy.

Data Item: subfield_name

The subfield_name attribute is the name for the second level within the taxonomy.

Data Item: subfield_desc

The subfield_desc attribute is the description of the second level within the taxonomy.

Data Item: keyword_field

The keyword_field attribute is to store keywords that might link to the field_name or field_desc attributes but is not part of the field_name or field_desc attributes.

Data Item: keyword_subfield

The keyword_subfield attribute is to store keywords that might link to the subfield_name or subfield_desc attributes but is not part of the subfield_name or subfield_desc attributes.

Reference List

Entity	Card	Dep.	Relationship
tblIK_Data	0,n	No	IK_Taxonomy

4.22. Entity: tblTrans

Name:	tblTrans
Generate Table:	Yes

The tblTrans entity holds information such as personal details, language, and the organisation to which translators and transcribers of the projects belong.

Attribute List

Name	Type	I	M
trans_id	LI	Yes	Yes
date	D	No	No

Data Item: trans_id

Primary Key of the tblTrans entity.

Data Item: date

Date on which information was added to the system.

Reference List

Entity	Card	Dep.	Relationship
tblTranslation	0,n	Yes	Translated_by
tblLanguage	1,n	No	Translation_Target_Language
tblLanguage	1,1	No	Translator_Language
tblLocation	1,1	No	Translator_Location
tblPersonal_Info	0,n	No	Translator_Transcriber_Personal_Info

4.23. Entity: tblTranscription

Name:	tblTranscription
Generate Table:	Yes

The tblTranscription entity stores the video or audio files that have been transcribed. Transcription is a text adaptation of an audio/video file.

Attribute List

Name	Type	I	M
transcribe_id	LI	Yes	Yes
date	D	No	No
source_text	TXT	No	No

Data Item: transcribe_id

Primary Key of the tblTranscription entity.

Data Item: date

Date on which information was added to the system.

Data Item: source_text

The source_desc attribute holds the transcription (typed text) of the audio or video file.

Reference List

Entity	Card	Dep.	Relationship
tblAudio_Video	1,1	No	Audio_Video_Transcription
tblTranslation	0,n	Yes	Transcription_Translated

4.24. Entity: tblTranslation

Name:	tblTranslation
Generate Table:	Yes

The tblTranslation entity stores the translations of transcriptions made from video or audio files. Translation is the conversion of text from one language to another.

Attribute List

Name	Type	I	M
translation_id	LI	Yes	Yes
target_lang	LA	No	No
target_text	TXT	No	No

Data Item: translation_id

Primary Key of the tblTranslation entity.

Data Item: target_lang

The target_lang attribute stores the target language. The target language is the language into which the translation is done.

Data Item: target_text

The target_text attribute stores the text that has been translated.

Reference List

Entity	Card	Dep.	Relationship
tblTranscription	1,1	Yes	Transcription_Translated
tblTrans	1,1	Yes	Translated_by

4.25. Entity: tblUser

Name:	tblUser
Generate Table:	Yes

The tblUser entity stores information about the users of the database. It contains their personal details, location, language, organisation, and user access level indicating to which information they will have access.

Attribute List

Name	Type	I	M
user_id	LI	Yes	Yes
date	D	No	No

Data Item: user_id

Primary Key of the tblUser entity.

Data Item: date

Date on which information was added to the system.

Reference List

Entity	Card	Dep.	Relationship
tblUser_Group_Access	0,n	No	User_Access_to_Group
tblPaid_Private_Access	0,n	No	User_Access_to_Paid_Private
tblLanguage	1,1	No	User_Language
tblOrganisation	1,1	No	User_Organisation
tblPersonal_Info	0,n	No	User_Personal_Info

4.26. Entity: tblUser_Group_Access

Name:	tblUser_Group_Access
Generate Table:	Yes

The tblUser_Access table is a bridge table. It allows the system to see whether a user has access to the knowledge of a group.

Attribute List

Name	Type	I	M	
access_type	I	No	No	
group_level_access	I	No	No	

Data Item: access_type

The access_type attribute stores only two values, i.e. 0 and 1. It indicates 0 - No the user does not have access to the group's information, or 1 - Yes the user does have access to the group's information. All groups are automatically set to 0.

Data Item: group_level_access

Within the group (community), information is classified at four levels: public, general (for whole community), traditional healers (only the traditional healers), and community leaders. This is to help with the classification and security of the knowledge.

Reference List

Entity	Card	Dep.	Relationship
tblIK_Data	0,1	No	Check_Access_Group
tblHolder	0,1	No	Holder_Access_to_Group
tblUser	0,1	No	User_Access_to_Group
tblGroup	0,1	No	User_Access_to_Group_Info

4.27. Entity: tblValidation

Name:	tblValidation
Generate Table:	Yes

The tblValidation entity holds information about the validation of the information. All IK information must be validated in some way.

Attribute List

Name	Type	I	M
validate_id	LI	Yes	Yes
date	D	No	No
method	TXT	No	No

Data Item: validate_id

Primary Key of the tblValidation entity.

Data Item: date

Date on which information was added to the system.

Data Item: method

The method attribute stores the process of how the validation is done.

Reference List

Entity	Card	Dep.	Relationship
tblIK_Data	1,1	Yes	IK_Validation
tblHolder	1,1	Yes	Validated_By

RELATIONSHIPS INFORMATION

4.1. Relationship: Audio_Video_Transcription

Name:	Audio_Video_Transcription
Entity 1:	tblAudio_Video
Entity 2:	tblTranscription
Cardinality:	One to One
Entity 2 dependent of Entity 1:	No

Role: The relationship specifies whether there could be transcriptions that belongs to stored audio/video files.

Entity 1 to Entity 2		**Entity 1 to Entity 2**	
Mandatory:	Yes	**Mandatory:**	Yes
Dominant:	No	**Dominant:**	No
Min, Max:	1, 1	**Min, Max:**	1, 1

4.2. Relationship: Check_Access_Group

Name:	Check_Access_Group
Entity 1:	tblIK_Data
Entity 2:	tblUser_Group_Access
Cardinality:	One to Many
Entity 2 dependent of Entity 1:	No

Role: The relationship helps to validate whether a user has access to a group's (community) knowledge.

Entity 1 to Entity 2		**Entity 2 to Entity 1**	
Mandatory:	No	**Mandatory:**	No
Dominant:	No	**Dominant:**	No
Min, Max:	0, n	**Min, Max:**	0, 1

4.3. Relationship: Check_Access_Paid

Name:		Check_Access_Paid	
Entity 1:		tblIK_Data	
Entity 2:		tblPaid_Private_Access	
Cardinality:		Many to Many	
Entity 2 dependent of Entity 1:		No	
Role: The relationship helps to validate whether a user has access to knowledge that has to be paid for.			
Entity 1 to Entity 2		**Entity 2 to Entity 1**	
Mandatory:	No	**Mandatory:**	No
Dominant:	No	**Dominant:**	No
Min, Max:	0, n	**Min, Max:**	0, n

4.4. Relationship: Fieldworker_Group

Name:		Fieldworker_Group	
Entity 1:		tblGroup	
Entity 2:		tblFieldWorker_DataCapturer	
Cardinality:		One to Many	
Entity 2 dependent of Entity 1:		No	
Role: The relationship is between the field worker and a group to which s/he may possibly belong.			
Entity 1 to Entity 2		**Entity 2 to Entity 1**	
Mandatory:	No	**Mandatory:**	Yes
Dominant:	No	**Dominant:**	No
Min, Max:	0, n	**Min, Max:**	1, 1

4.5. Relationship: Fieldworker_Language

Name:		Fieldworker_Language	
Entity 1:		tblLanguage	
Entity 2:		tblFieldWorker_DataCapturer	
Cardinality:		One to Many	
Entity 2 dependent of Entity 1:		No	
Role: The relationship specifies the language spoken by the field workers and data capturers.			
Entity 1 to Entity 2		**Entity 2 to Entity 1**	
Mandatory:	No	**Mandatory:**	Yes
Dominant:	No	**Dominant:**	No
Min, Max:	0, n	**Min, Max:**	1, 1

4.6. Relationship: FieldworkerDataCapturer_Personal_Info

Name:		FieldworkerDataCapturer_Personal_Info	
Entity 1:		tblFieldWorker_DataCapturer	
Entity 2:		tblPersonal_Info	
Cardinality:		One to Many	
Entity 2 dependent of Entity 1:		No	
Role: The relationship is to the personal information of the field workers and data capturers.			
Entity 1 to Entity 2		**Entity 2 to Entity 1**	
Mandatory:	No	**Mandatory:**	Yes
Dominant:	No	**Dominant:**	No
Min, Max:	0, n	**Min, Max:**	1, 1

4.7. Relationship: Holder_Access_to_Group

Name:		Holder_Access_to_Group	
Entity 1:		tblHolder	
Entity 2:		tblUser_Group_Access	
Cardinality:		One to Many	
Entity 2 dependent of Entity 1:		No	
Role: This relationship specifies what access each IK holder that belong to a group has.			
Entity 1 to Entity 2		**Entity 2 to Entity 1**	
Mandatory:	No	**Mandatory:**	No
Dominant:	No	**Dominant:**	No
Min, Max:	0, n	**Min, Max:**	0, 1

4.8. Relationship: Holder_Group

Name:		Holder_Group	
Entity 1:		tblGroup	
Entity 2:		tblHolder	
Cardinality:		One to Many	
Entity 2 dependent of Entity 1:		No	
Role: This relationship specifies that each IK holder must belong to a group.			
Entity 1 to Entity 2		**Entity 2 to Entity 1**	
Mandatory:	No	**Mandatory:**	Yes
Dominant:	No	**Dominant:**	No
Min, Max:	0, n	**Min, Max:**	1, 1

4.9. Relationship: Holder_Language

Name:		Holder_Language	
Entity 1:		tblLanguage	
Entity 2:		tblHolder	
Cardinality:		One to Many	
Entity 2 dependent of Entity 1:		No	
Role: The relationship specifies the language spoken by the IK holder.			
Entity 1 to Entity 2		**Entity 2 to Entity 1**	
Mandatory:	No	**Mandatory:**	Yes
Dominant:	No	**Dominant:**	No
Min, Max:	0, n	**Min, Max:**	1, 1

4.10. Relationship: IK_Access_Level

Name:		IK_Access_Level	
Entity 1:		tblAccess_Level	
Entity 2:		tblIK_Data	
Cardinality:		One to Many	
Entity 2 dependent of Entity 1:		No	
Role: The relationship is between the IK Data record and the level of access that is required to see the knowledge.			
Entity 1 to Entity 2		**Entity 2 to Entity 1**	
Mandatory:	No	**Mandatory:**	No
Dominant:	No	**Dominant:**	No
Min, Max:	0, n	**Min, Max:**	0, 1

4.11. Relationship: IK_Audio

Name:		IK_Audio	
Entity 1:		tblIK_Data	
Entity 2:		tblAudio_Video	
Cardinality:		One to Many	
Entity 2 dependent of Entity 1:		No	
Role: The relationship specifies that the IK data record may have audio/video files.			
Entity 1 to Entity 2		**Entity 2 to Entity 1**	
Mandatory:	No	**Mandatory:**	Yes
Dominant:	No	**Dominant:**	No
Min, Max:	0, n	**Min, Max:**	1, 1

4.12. Relationship: IK_Bearer_of_Knowledge

Name:		IK_Bearer_of_Knowledge	
Entity 1:		tblBearer_of_Knowledge	
Entity 2:		tblIK_Data	
Cardinality:		Many to Many	
Entity 2 dependent of Entity 1:		No	
Role: The relationship is between the IK data and whoever bears the knowledge.			
Entity 1 to Entity 2		**Entity 2 to Entity 1**	
Mandatory:	No	**Mandatory:**	Yes
Dominant:	No	**Dominant:**	No
Min, Max:	0, n	**Min, Max:**	1, n

4.13. Relationship: IK_Context_of_Exchange

Name:		IK_Context_of_Exchange	
Entity 1:		tblContext_of_Exchange	
Entity 2:		tblIK_Data	
Cardinality:		One to Many	
Entity 2 dependent of Entity 1:		No	
Role: The relationship is between the IK data and the context of the knowledge.			
Entity 1 to Entity 2		**Entity 2 to Entity 1**	
Mandatory:	No	**Mandatory:**	No
Dominant:	No	**Dominant:**	No
Min, Max:	0, n	**Min, Max:**	0, 1

4.14. Relationship: IK_Data_Language

Name:		IK_Data_Language	
Entity 1:		tblLanguage	
Entity 2:		tblIK_Data	
Cardinality:		One to Many	
Entity 2 dependent of Entity 1:		No	
Role: The relation specifies the language in which the IK data is captured.			
Entity 1 to Entity 2		**Entity 2 to Entity 1**	
Mandatory:	No	**Mandatory:**	Yes
Dominant:	No	**Dominant:**	No
Min, Max:	0, n	**Min, Max:**	1, 1

4.15. Relationship: IK_Fieldworker

Name:	IK_Fieldworker
Entity 1:	tblFieldWorker_DataCapturer
Entity 2:	tblIK_Data
Cardinality:	One to Many
Entity 2 dependent of Entity 1:	No

Role: The relationship specifies who did the field work and who captured the data on the database, for each IK data record.

Entity 1 to Entity 2		**Entity 2 to Entity 1**	
Mandatory:	No	**Mandatory:**	No
Dominant:	No	**Dominant:**	No
Min, Max:	0, n	**Min, Max:**	0, 1

4.16. Relationship: IK_Gathered_by

Name:	IK_Gathered_by
Entity 1:	tblOrganisation
Entity 2:	tblIK_Data
Cardinality:	One to Many
Entity 2 dependent of Entity 1:	No

Role: The relationship specifies which organisation was involved in capturing the knowledge.

Entity 1 to Entity 2		**Entity 2 to Entity 1**	
Mandatory:	No	**Mandatory:**	No
Dominant:	No	**Dominant:**	No
Min, Max:	0, n	**Min, Max:**	0, 1

4.17. Relationship: IK_Holder

Name:		IK_Holder	
Entity 1:		tblHolder	
Entity 2:		tblIK_Data	
Cardinality:		One to Many	
Entity 2 dependent of Entity 1:		No	
Role: The relationship shows from which IK holder the IK data was collected.			
Entity 1 to Entity 2		**Entity 2 to Entity 1**	
Mandatory:	No	**Mandatory:**	No
Dominant:	No	**Dominant:**	No
Min, Max:	0, n	**Min, Max:**	0, 1

4.18. Relationship: IK_Holder_Personal_Info

Name:		IK_Holder_Personal_Info	
Entity 1:		tblHolder	
Entity 2:		tblPersonal_Info	
Cardinality:		One to Many	
Entity 2 dependent of Entity 1:		No	
Role: The relationship is to the personal information of the IK holder.			
Entity 1 to Entity 2		**Entity 2 to Entity 1**	
Mandatory:	No	**Mandatory:**	Yes
Dominant:	No	**Dominant:**	No
Min, Max:	0, n	**Min, Max:**	1, 1

4.19. Relationship: IK_Image

Name:		IK_Image	
Entity 1:		tblIK_Data	
Entity 2:		tblImage	
Cardinality:		One to Many	
Entity 2 dependent of Entity 1:		No	
Role: The relationship specifies that the IK data record may have picture files.			
Entity 1 to Entity 2		**Entity 2 to Entity 1**	
Mandatory:	No	**Mandatory:**	Yes
Dominant:	No	**Dominant:**	No
Min, Max:	0, n	**Min, Max:**	1, 1

4.20. Relationship: IK_Location

Name:		IK_Location	
Entity 1:		tblLocation	
Entity 2:		tblIK_Data	
Cardinality:		One to Many	
Entity 2 dependent of Entity 1:		No	
Role: The relationship specifies where the IK data may be located.			
Entity 1 to Entity 2		**Entity 2 to Entity 1**	
Mandatory:	No	**Mandatory:**	Yes
Dominant:	No	**Dominant:**	No
Min, Max:	0, n	**Min, Max:**	1, 1

4.21. Relationship: IK_Means_of _Exchange

Name:		IK_Means_of _Exchange	
Entity 1:		tblMeans_of_Exchange	
Entity 2:		tblIK_Data	
Cardinality:		One to Many	
Entity 2 dependent of Entity 1:		No	
Role: The relationship is between the IK data and how knowledge is transferred.			
Entity 1 to Entity 2		**Entity 2 to Entity 1**	
Mandatory:	No	**Mandatory:**	Yes
Dominant:	No	**Dominant:**	No
Min, Max:	0, n	**Min, Max:**	1, 1

4.22. Relationship: IK_Mode_of_Exchange

Name:		IK_Mode_of_Exchange	
Entity 1:		tblMode_of_Exchange	
Entity 2:		tblIK_Data	
Cardinality:		Many to Many	
Entity 2 dependent of Entity 1:		No	
Role: The relationship is between the IK data and whoever transfers the knowledge.			
Entity 1 to Entity 2		**Entity 2 to Entity 1**	
Mandatory:	No	**Mandatory:**	Yes
Dominant:	No	**Dominant:**	No
Min, Max:	0, n	**Min, Max:**	1, n

4.23. Relationship: IK_Other_Names

Name:		IK_Other_Names	
Entity 1:		tblOther_Name	
Entity 2:		tblIK_Data	
Cardinality:		One to Many	
Entity 2 dependent of Entity 1:		No	
Role: The relationship specifies other possible names the IK data may be known as.			
Entity 1 to Entity 2		**Entity 2 to Entity 1**	
Mandatory:	Yes	**Mandatory:**	No
Dominant:	No	**Dominant:**	No
Min, Max:	1, n	**Min, Max:**	0, 1

4.24. Relationship: IK_PRA_Technique

Name:		IK_PRA_Technique	
Entity 1:		tblPRA_technique	
Entity 2:		tblIK_Data	
Cardinality:		Many to Many	
Entity 2 dependent of Entity 1:		No	
Role: The relationship specifies the PRA techniques used to capture the IK data.			
Entity 1 to Entity 2		**Entity 2 to Entity 1**	
Mandatory:	No	**Mandatory:**	Yes
Dominant:	No	**Dominant:**	No
Min, Max:	0, n	**Min, Max:**	1, n

4.25. Relationship: IK_Samples_Collected

Name:		IK_Samples_Collected	
Entity 1:		tblIK_Data	
Entity 2:		tblSamples_Collected	
Cardinality:		One to Many	
Entity 2 dependent of Entity 1:		No	
Role: The relationship specifies whether any samples of the IK data was collected.			
Entity 1 to Entity 2		**Entity 2 to Entity 1**	
Mandatory:	No	**Mandatory:**	Yes
Dominant:	No	**Dominant:**	No
Min, Max:	0, n	**Min, Max:**	1, 1

4.26. Relationship: IK_Taxonomy

Name:		IK_Taxonomy	
Entity 1:		tblTaxonomy	
Entity 2:		tblIK_Data	
Cardinality:		One to Many	
Entity 2 dependent of Entity 1:		No	
Role: The relationship is between the IK data and the taxonomy.			
Entity 1 to Entity 2		**Entity 2 to Entity 1**	
Mandatory:	No	**Mandatory:**	Yes
Dominant:	No	**Dominant:**	No
Min, Max:	0, n	**Min, Max:**	1, 1

4.27. Relationship IK_Validation

Name:		IK_Validation	
Entity 1:		tblIK_Data	
Entity 2:		tblValidation	
Cardinality:		One to Many	
Entity 2 dependent of Entity 1:		Yes	
Role: The relationship specifies who had done the validation of the IK data.			
Entity 1 to Entity 2		**Entity 2 to Entity 1**	
Mandatory:	No	**Mandatory:**	Yes
Dominant:	No	**Dominant:**	No
Min, Max:	0, n	**Min, Max:**	1, 1

4.28. Relationship: Location_Group

Name:		Location_Group	
Entity 1:		tblLocation	
Entity 2:		tblGroup	
Cardinality:		One to Many	
Entity 2 dependent of Entity 1:		No	
Role: The relationship specifies where the group (community) is located.			
Entity 1 to Entity 2		**Entity 2 to Entity 1**	
Mandatory:	No	**Mandatory:**	Yes
Dominant:	No	**Dominant:**	No
Min, Max:	0, n	**Min, Max:**	1, 1

4.29. Relationship: Original_Audio_Video

Name:		Original_Audio_Video	
Entity 1:		tblAudio_Video	
Entity 2:		tblOrg_Audio_Video	
Cardinality:		One to One	
Entity 2 dependent of Entity 1:		Yes	
Role: The relationship is between the edited audio/video files and the original audio/video files.			
Entity 1 to Entity 2		**Entity 2 to Entity 1**	
Mandatory:	No	**Mandatory:**	Yes
Dominant:	No	**Dominant:**	No
Min, Max:	0, 1	**Min, Max:**	1, 1

4.30. Relationship: Related_To_Source

Name:		related_to_source	
Entity 1:		tblIK_Data	
Entity 2:		tblIK_Data	
Cardinality:		One to Many	
Entity 2 dependent of Entity 1:		No	
Role: The relationship is between IK data and IK data indicating possible related sources in the entity.			
Entity 1 to Entity 2		**Entity 2 to Entity 1**	
Mandatory:	No	**Mandatory:**	No
Dominant:	No	**Dominant:**	No
Min, Max:	0, n	**Min, Max:**	0, 1

4.31. Relationship: Transcription_Translated

Name:		Transcription_Translated	
Entity 1:		tblTranscription	
Entity 2:		tblTranslation	
Cardinality:		One to Many	
Entity 2 dependent of Entity 1:		Yes	
Role: The relationship is between the transcription and the translation thereof.			
Entity 1 to Entity 2		**Entity 2 to Entity 1**	
Mandatory:	No	**Mandatory:**	Yes
Dominant:	No	**Dominant:**	No
Min, Max:	0, n	**Min, Max:**	1, 1

4.32. Relationship: Translated_by

Name:		Translated_by	
Entity 1:		tblTrans	
Entity 2:		tblTranslation	
Cardinality:		One to Many	
Entity 2 dependent of Entity 1:		Yes	
Role: The relationship is between the translation and the person responsible for the translation, the translator.			
Entity 1 to Entity 2		**Entity 2 to Entity 1**	
Mandatory:	No	**Mandatory:**	Yes
Dominant:	No	**Dominant:**	No
Min, Max:	0, n	**Min, Max:**	1, 1

4.33. Relationship: Translation_Target_Language

Name:	Translation_Target_Language
Entity 1:	tblLanguage
Entity 2:	tblTrans
Cardinality:	Many to Many
Entity 2 dependent of Entity 1:	No

Role: The relationship is between the translation and the target language (language translated into).

Entity 1 to Entity 2		**Entity 2 to Entity 1**	
Mandatory:	No	**Mandatory:**	Yes
Dominant:	No	**Dominant:**	No
Min, Max:	0, n	**Min, Max:**	1, n

4.34. Relationship: Translator_Language

Name:	Translator_Language
Entity 1:	tblLanguage
Entity 2:	tblTrans
Cardinality:	One to Many
Entity 2 dependent of Entity 1:	No

Role: The relationship is between the translator and language, specifying the translator's language.

Entity 1 to Entity 2		**Entity 2 to Entity 1**	
Mandatory:	No	**Mandatory:**	Yes
Dominant:	No	**Dominant:**	No
Min, Max:	0, n	**Min, Max:**	1, 1

4.35. Relationship: Translator_Location

Name:		Translator_Location	
Entity 1:		tblLocation	
Entity 2:		tblTrans	
Cardinality:		One to Many	
Entity 2 dependent of Entity 1:		No	
Role: The relationship specifies the translators location.			
Entity 1 to Entity 2		**Entity 2 to Entity 1**	
Mandatory:	No	**Mandatory:**	Yes
Dominant:	No	**Dominant:**	No
Min, Max:	0, n	**Min, Max:**	1, 1

4.36. Relationship: Translator_Transcriber_Personal_Info

Name:		Translator_Transcriber_Personal_Info	
Entity 1:		tblTrans	
Entity 2:		tblPersonal_Info	
Cardinality:		One to Many	
Entity 2 dependent of Entity 1:		No	
Role: The relationship is to the personal information of the translator/transcriber.			
Entity 1 to Entity 2		**Entity 2 to Entity 1**	
Mandatory:	No	**Mandatory:**	Yes
Dominant:	No	**Dominant:**	No
Min, Max:	0, n	**Min, Max:**	1, 1

4.37. Relationship: User_Access_to_Group

Name:		User_Access_to_Group	
Entity 1:		tblUser	
Entity 2:		tblUser_Group_Access	
Cardinality:		One to Many	
Entity 2 dependent of Entity 1:		No	
Role: The relationship is between group access and the user.			
Entity 1 to Entity 2		**Entity 2 to Entity 1**	
Mandatory:	No	**Mandatory:**	No
Dominant:	No	**Dominant:**	No
Min, Max:	0, n	**Min, Max:**	0, 1

4.38. Relationship: User_Access_to_Group_Info

Name:		User_Access_to_Group_Info	
Entity 1:		tblGroup	
Entity 2:		tblUser_Group_Access	
Cardinality:		One to Many	
Entity 2 dependent of Entity 1:		No	
Role: The relationship is between group access and the group.			
Entity 1 to Entity 2		**Entity 2 to Entity 1**	
Mandatory:	No	**Mandatory:**	No
Dominant:	No	**Dominant:**	No
Min, Max:	0, n	**Min, Max:**	0, 1

4.39. Relationship: User_Access_to_Paid_Private

Name:		User_Access_to_Paid_Private	
Entity 1:		tblUser	
Entity 2:		tblPaid_Private_Access	
Cardinality:		One to Many	
Entity 2 dependent of Entity 1:		No	
Role: The relationship specifies to which access the user has paid access.			
Entity 1 to Entity 2		**Entity 2 to Entity 1**	
Mandatory:	No	**Mandatory:**	No
Dominant:	No	**Dominant:**	No
Min, Max:	0, n	**Min, Max:**	0, 1

4.40. Relationship: User_Language

Name:		User_Language	
Entity 1:		tblLanguage	
Entity 2:		tblUser	
Cardinality:		One to Many	
Entity 2 dependent of Entity 1:		No	
Role: The relationship specifies what the user's language is.			
Entity 1 to Entity 2		**Entity 2 to Entity 1**	
Mandatory:	No	**Mandatory:**	Yes
Dominant:	No	**Dominant:**	No
Min, Max:	0, n	**Min, Max:**	1, 1

4.41. Relationship: User_Organisation

Name:		User_Organisation	
Entity 1:		tblOrganisation	
Entity 2:		tblUser	
Cardinality:		One to Many	
Entity 2 dependent of Entity 1:		No	
Role: The relationship specifies to which organisation the user belongs.			
Entity 1 to Entity 2		**Entity 2 to Entity 1**	
Mandatory:	No	**Mandatory:**	Yes
Dominant:	No	**Dominant:**	No
Min, Max:	0, n	**Min, Max:**	1, 1

4.42. Relationship: User_Personal_Info

Name:		User_Personal_Info	
Entity 1:		tblUser	
Entity 2:		tblPersonal_Info	
Cardinality:		One to Many	
Entity 2 dependent of Entity 1:		No	
Role: The relationship is to the personal information of the user.			
Entity 1 to Entity 2		**Entity 2 to Entity 1**	
Mandatory:	No	**Mandatory:**	Yes
Dominant:	No	**Dominant:**	No
Min, Max:	0, n	**Min, Max:**	1, 1

4.43. Relationship: Validated_By

Name:		Validated_By	
Entity 1:		tblHolder	
Entity 2:		tblValidation	
Cardinality:		One to Many	
Entity 2 dependent of Entity 1:		Yes	
Role: The relationship is between the IK holders and validation done by them.			
Entity 1 to Entity 2		**Entity 2 to Entity 1**	
Mandatory:	No	**Mandatory:**	Yes
Dominant:	No	**Dominant:**	No
Min, Max:	0, n	**Min, Max:**	1, 1

4.44. Relationship: Worker_Location

Name:		Worker_Location	
Entity 1:		tblLocation	
Entity 2:		tblFieldWorker_DataCapturer	
Cardinality:		One to Many	
Entity 2 dependent of Entity 1:		No	
Role: The relationship shows the location of the field worker and data capturers.			
Entity 1 to Entity 2		**Entity 2 to Entity 1**	
Mandatory:	No	**Mandatory:**	No
Dominant:	No	**Dominant:**	No
Min, Max:	0, n	**Min, Max:**	0, 1

4.45. Relationship: Worker_Organisation

Name:		Worker_Organisation	
Entity 1:		tblOrganisation	
Entity 2:		tblFieldWorker_DataCapturer	
Cardinality:		One to Many	
Entity 2 dependent of Entity 1:		No	
Role: The relationship is between the field workers/data capturers and the organisation to which they belong.			
Entity 1 to Entity 2		**Entity 2 to Entity 1**	
Mandatory:	No	**Mandatory:**	Yes
Dominant:	No	**Dominant:**	No
Min, Max:	0, n	**Min, Max:**	1, 1

The next section (4.3) will show screen shots of an archetype user interface that can be used in conjunction with the IK database. The user interface has been developed as an extra to show the functionality of the IK Database and is in no way a complete, researched interface or does not form such an interface.

4.3. GRAPHICAL USER INTERFACE

The GUI will show a graphical depiction of what a possible interface could look like. The idea of the interface is not to fully develop the system but only graphically to represent the database in order to portray some database functionalities. The three functionalities that will be depicted are how to search for IK, how to add a new member to the database, and how to capture new data. In order to truly develop such an interface, community input is needed because determining their needs, wants, and capability is of the utmost importance.

The first screenshot shows the login screen. Each user must log in on the database in order to obtain access to any of the information in the IK

database. There are six groups to which a user can belong: IK holder, field worker, data capturer, transcriber, translator, and a system user who is not part of the project but only a user of the system.

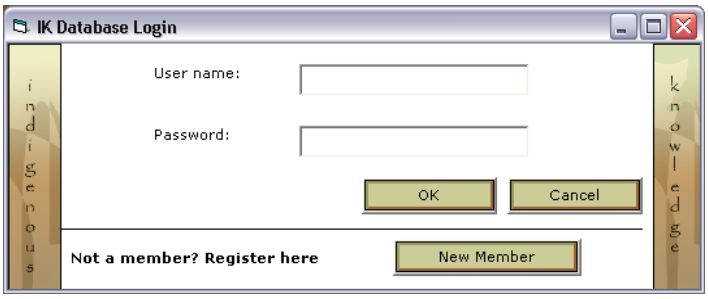


Figure 4.2 Login screen

4.3.1. Add a new member

If the person is not a member, the correct procedure is to first register on the system. The following screen depicts the New Member Registration.

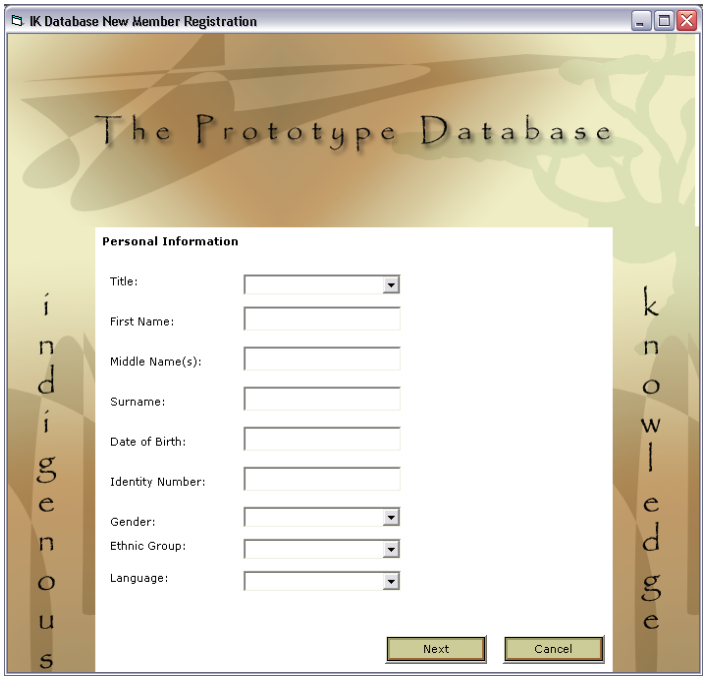


Figure 4.3 First New Members screen

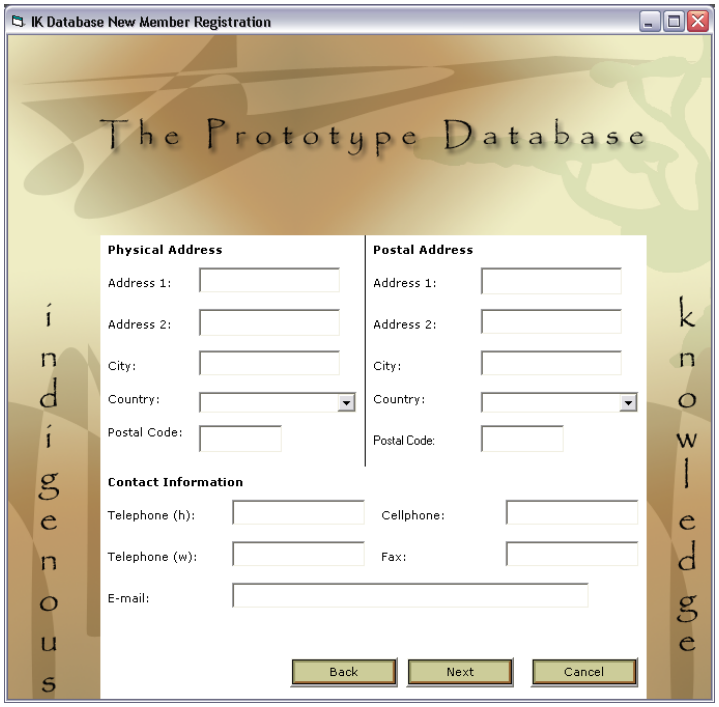


Figure 4.4 Second New Members screen

Both Figure 4.3 and 4.4 is to be completed in full by all six group members.

Depending on the group(s) the user selects (top of Figure 4.5), the following information (marked with X) will be made available for completion by the registering new member.

Group	Community	Organisation	Location	Role of IK holder in community
IK holder	X		X	X
Field worker	X	X	X	
Data capturer		X		
Transcribers		X	X	
Translator		X	X	
System user		X		

Table 4.1 Registration for new members: selected information displayed, depending on group selection

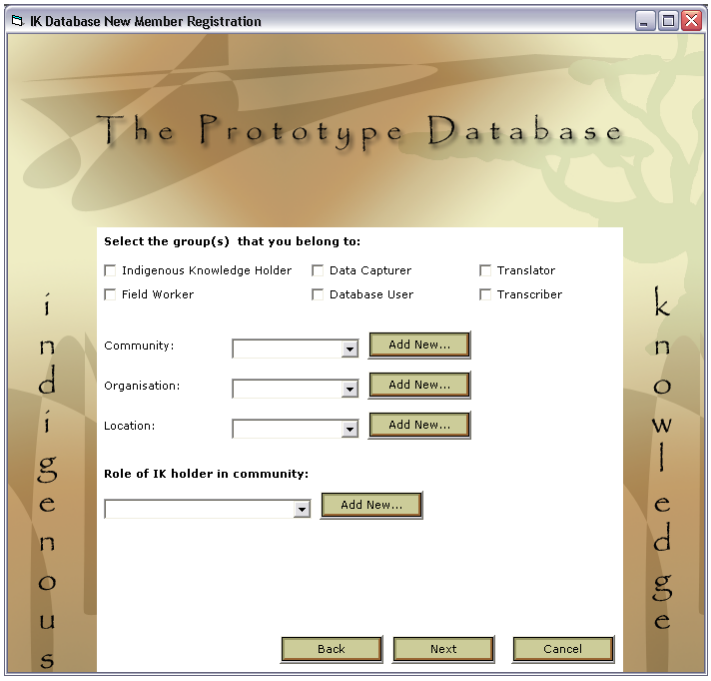


Figure 4.5 Third New Member screen

The final screen of new member registration allows the user to select a user name and password (also verifies the password) and includes a field where any additional information, which the user feels should be known, can be entered.

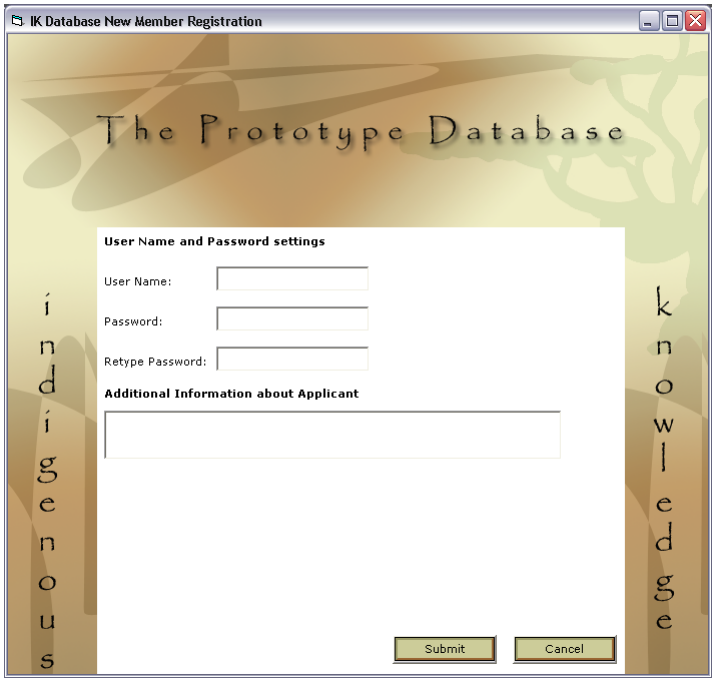


Figure 4.6 Fourth New Member screen

The next screen (if the registration has been successful so far) is a message screen indicating that someone will be in touch to complete the registration. This is done so that the information of users in different groups can be verified.

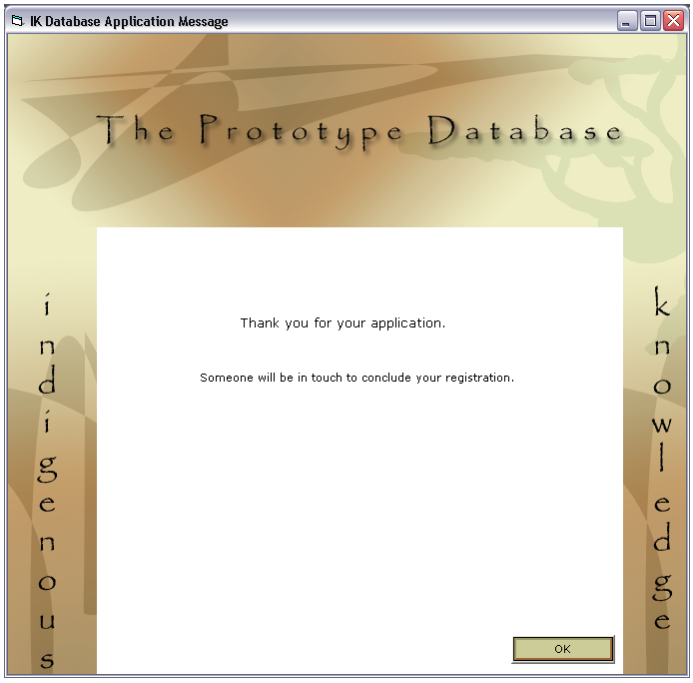


Figure 4.7 New Member message screen

This concludes the new member registration section. The next section deals with how to capture new IK in the database.

4.3.2. Capturing data

The section's screenshots show the method of the prototype GUI for capturing new IK. The assumption is that the user is logged into the system. In Figure 4.2, the username and password fields have been completed and the OK button has been clicked.

The next screen to appear is the main screen (Figure 4.8). On this screen, there are two options: one is to search for information (to be discussed in section 4.3.3), and the other is to add new IK. The terminology used on the screen is "Capture Data" because that is the terminology used in the field of data capturing.

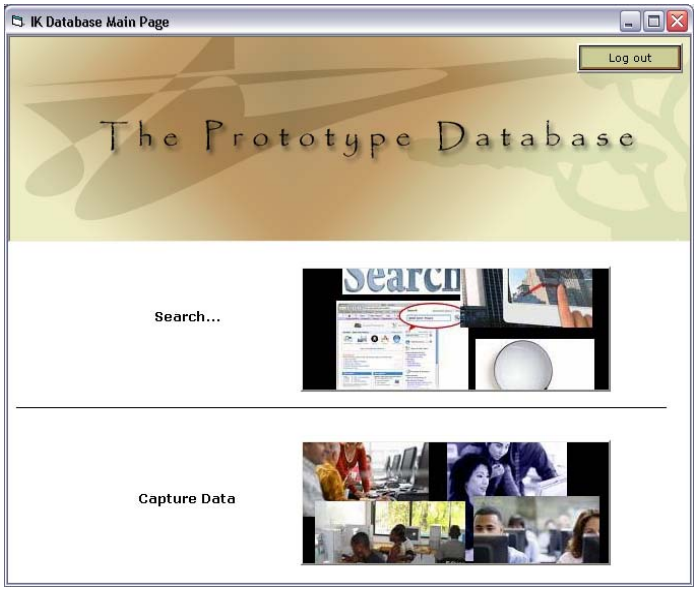


Figure 4.8 Main screen of prototype GUI

If the user clicks on the “Capture Data” button, the screen as portrayed in Figure 4.9 is displayed, and IK that has been gathered in the field by the field worker can be captured in the database. The descriptions of the fields that will be entered can be found in section 4.2, the CDM report.

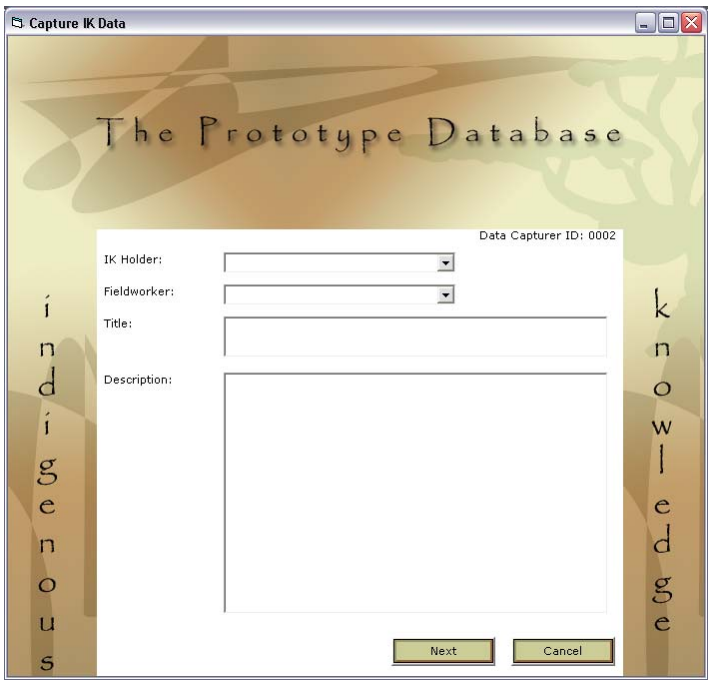


Figure 4.9 First Capture IK Data screen

The fields “Title” and “Description” refer to the IK record being entered.

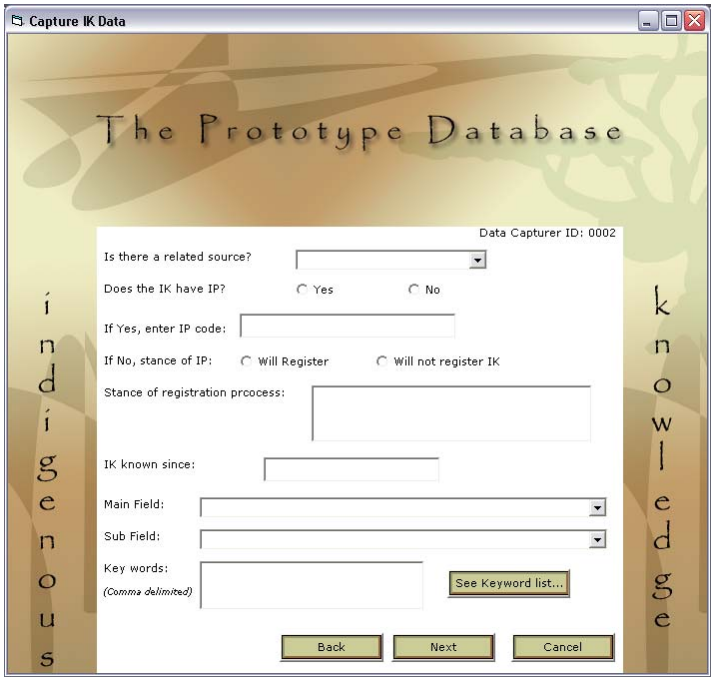


Figure 4.10 Second Capture IK Data screen

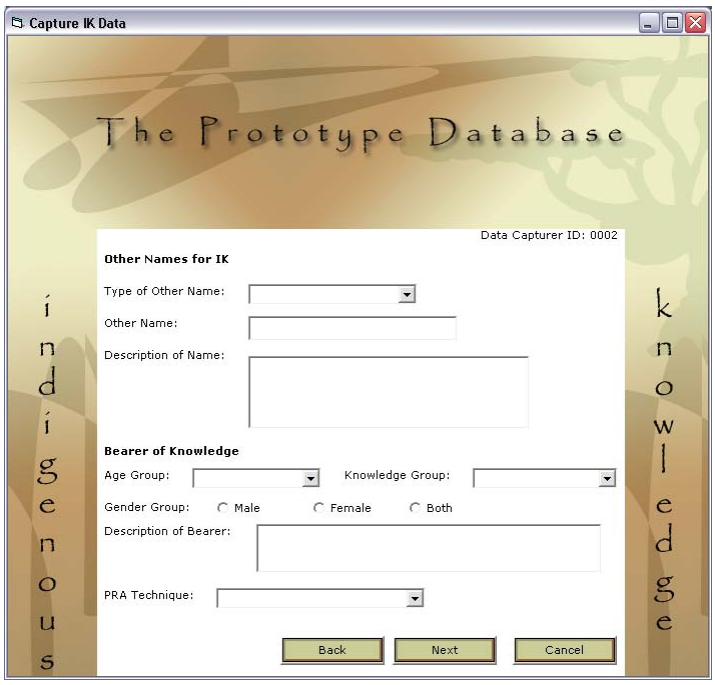


Figure 4.11 Third Capture IK Data screen

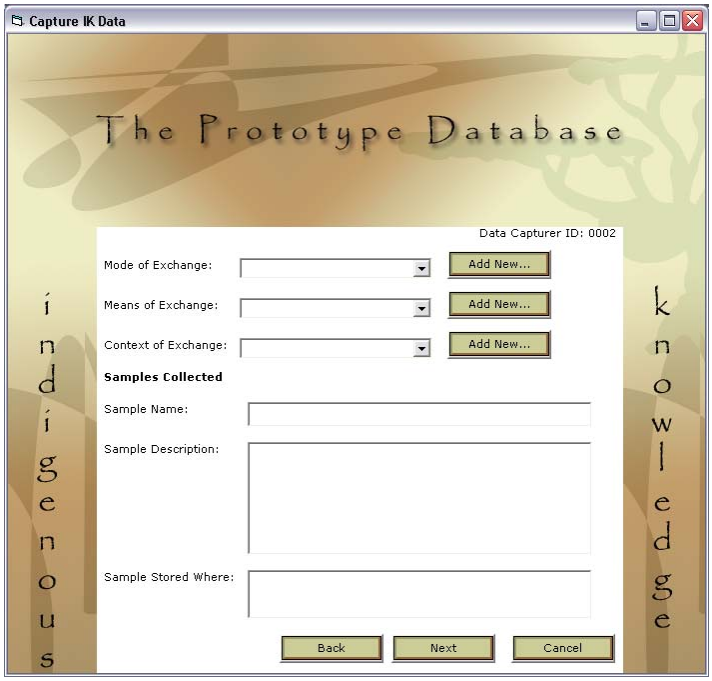


Figure 4.12 Fourth Capture IK Data screen

On the final screen (Figure 4.13), there are “Request” options for transcribing and translating the IK. The reason for a request instead of a demand or rather direct instruction is that a data capturer cannot determine whether information should be transcribed or translated. The alternative solution is for the data capturer to request a transcription or translation and to let a higher authority decide whether the request is valid or not.

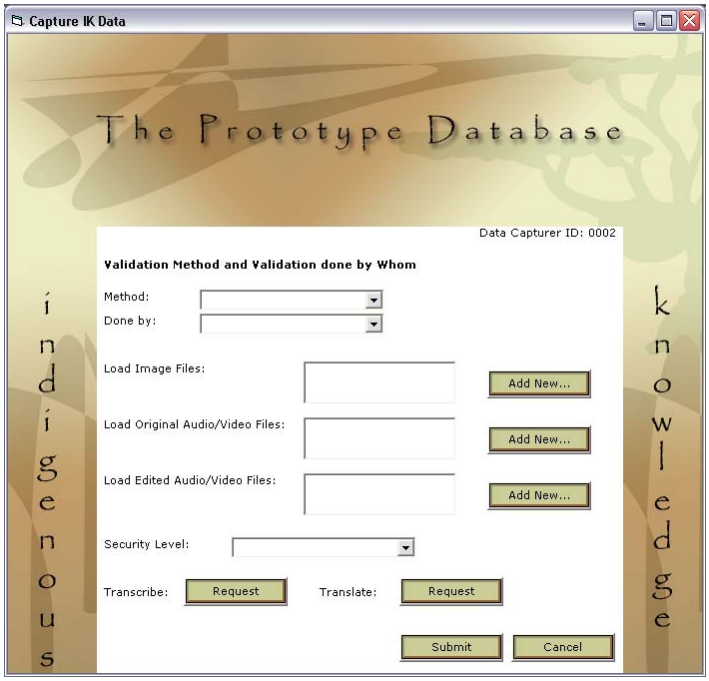


Figure 4.13 Fifth and final Capture IK Database screen

As is the case with the new member application screens, a message screen is displayed to the user indicating the status of the submission.

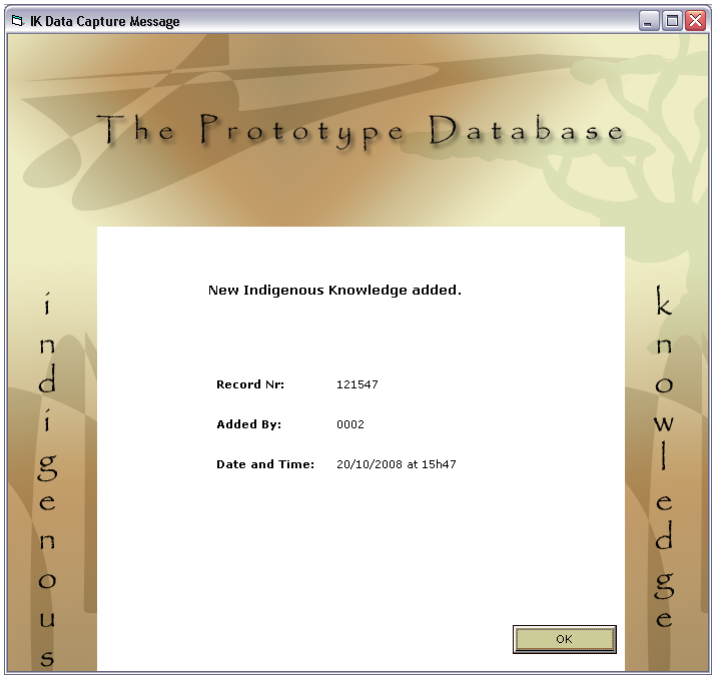


Figure 4.14 Capture IK Data message screen

4.3.3. Search for IK

The search for IK is the final part of the prototype GUI. The user can access the search function by clicking on the search button on the main screen (Figure 4.8).

The following screen, Figure 4.15, allows the user to search for information in the database. There are three methods for searching. The first search is by topic i.e. Informal Education, Mother and Child care, Past Harvest Technology, etc. Once a main topic has been chosen, the sub-topics of the chosen topic will be loaded in order to allow a refined search, but the sub-topic option can also be left blank. The second search option is to search for a particular record. The search can be done by using the title, part of the description, topics (main and sub), keyword search, IK Holder, language, etc. The second more open search will basically allow you to search on any field within the database, but only retrieving IK records to which the user has access. The third search allows users to retrieve records to which they

are linked. The IK records in which the user has been involved as, for instance, the data capturer or field worker will be retrieved.

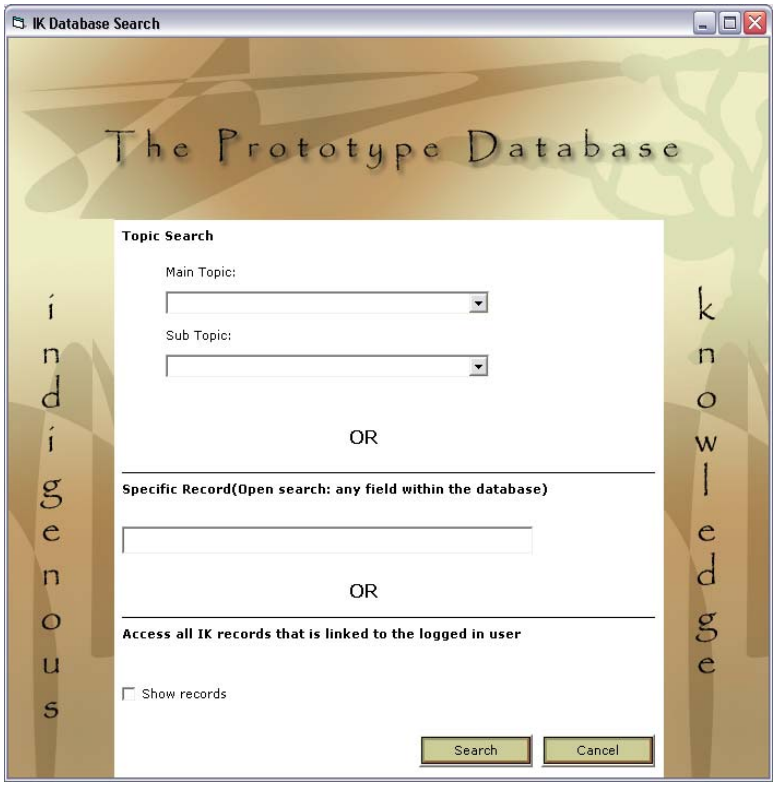


Figure 4.15 IK Database search screen

The final screen (Figure 4.16) presents the retrieved results to the user.

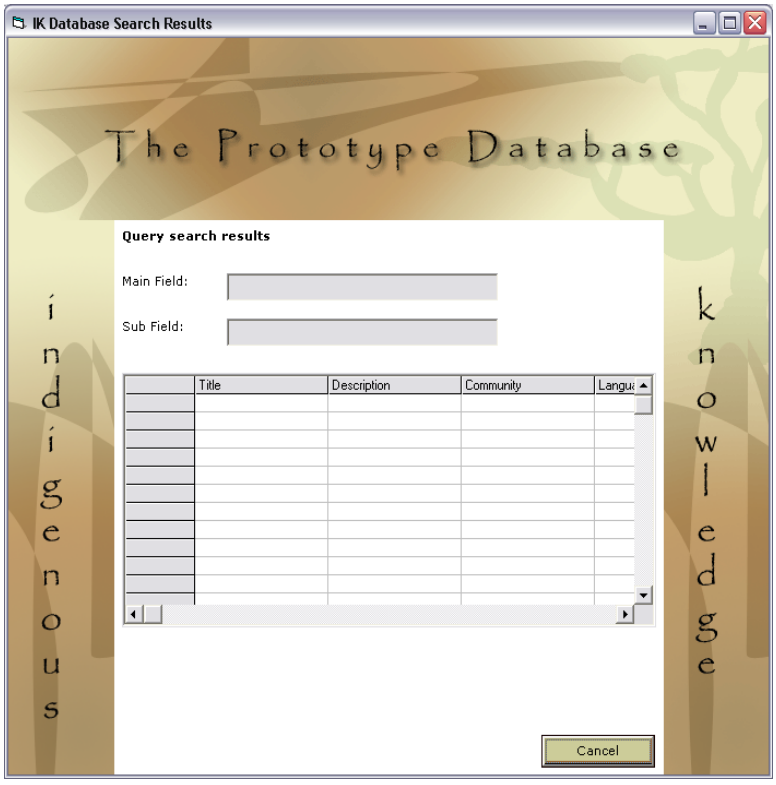


Figure 4.16 IK Database Search Results screen

CHAPTER 5

Conclusion

5.1 INTRODUCTION

The purpose of the study has been to design and develop a prototype IK database that will be appropriate and productive within a KM framework specifically focused on IK. The design of the IK database took cognisance of what is currently prevailing in South Africa and the rest of the world with respect to IK and database development. The development of the database was done in such a way as to establish a standard database design for IK systems in South Africa. At a later time, the databases could be inter-linked and South Africa can have one large knowledge repository for IK. Holders of IK, whether individual or collectively, in particular within the indigenous people's organizations, have a claim that their knowledge should not be exploited for elitist purposes without direct benefit to their empowerment and the improvement of their livelihoods. The importance of IK is that IK provides the basis for problem-solving strategies for local communities, especially the poor; this can help reduce poverty. IK is a key element of the "social capital" of the poor; it is their main asset to invest in the struggle for survival, to produce food, to provide shelter, or to achieve control over their own lives. It is closely intertwined with their livelihoods.

Many aspects of KM and IK were discussed, and a feasibility study concerning a KM framework was conducted to determine if any existing KM frameworks can work in an organisation that works with IK. The discussion included other factors that influence IK and they are: guidelines for implementing a KM framework, information management, quality management, human factors/capital movement, leading role players in the field of IK, IPR, ethics, guidelines for doing fieldwork, and a best plan for

implementation. After an in-depth study of some outstanding KM frameworks, the KM Threefold Framework Life Cycle Model was put forward as a possible solution for the KM framework within the field of IK.

At this point, the focus changed from KM and IK to the prototype IK database and the technical design thereof. The design and development factors of the IK database started with the Life Cycles, SDLC and the DBLC. Another factor that was looked at is the four main stages of the database design: conceptual design, DBMS software selection, logical design, and physical design. Thus far, the focus has been on how to develop the database and what tools to use, but the focus was shifted to the more hands-on development by looking at the different data models and their underlying models. The conceptual design stage used data modelling to create an abstract database structure that represents real-world objects in the most authentic way possible. The tools used to design the database are platform independent software; therefore the design can be implemented on many different platforms. The software is called PowerDesigner Data Architect version 6. An elementary prototype GUI was designed in order to illustrate the database's three main functions: adding new members, adding a new IK record, and searching the IK database.

5.2 ACHIEVEMENTS

The two main achievements could be put to words as follows. The first achievement pertains to identifying the KM Threefold Framework Life Cycle Model as a possible solution to helping the management of IK during, before, and after collection. Not only looking at IK, but also focussed on other environmental influences such as culture, infrastructure, purpose, strategy, acquiring knowledge, selecting knowledge, resource influences, managerial influences, and environmental influences.

The second achievement is designing a prototype IK database that can be utilised by more than just a select few. Researches in the field of IK can have access to an already designed IK database to use in their research without the need for time consuming research to design a database. A singular platform used by researchers also means they can collaborate more easily. They have a template on which to start their work that can be expanded as their needs and uses grow and develop.

The two achievements were marked as the highest priority at the beginning of the study and both could be achieved. An overall achievement was perhaps becoming cognisant of how complex working with people's own knowledge is, and how careful one should be not to underestimate the value thereof for the communities.

5.3 PROBLEMS ENCOUNTERED

Talking about communities as one group that comes on board an IK project is an oversimplification. The assumption made is that people in communities will all work together and be on board, but this will take time and effort to achieve. Assurance of intentions and relationship building will help with this effort.

Perhaps the biggest problem encountered was researching other IK databases of this nature (or any nature) from within the IT paradigm. It seems that researchers are not documenting their design and development processes. This might be because they are not in the field of IT, and therefore, this is not an important component for them.

5.4 SUGGESTIONS FOR FURTHER STUDY

The KM Threefold Framework Life Cycle Model (as suggested in Chapter 2) will need to be implemented in the field, and this will most probably lead to some adjustments in the KM framework once it has been tested. The prototype IK database is open for further expansion. Once some field work is done, more areas for improvement will be identified.

Another area that definitely needs more research is the GUI. The GUI included in this thesis is for illustration purposes only and is by no means complete or fully researched. The following aspects need to be looked at from a research point of view.

1. What is the literacy rate of the communities involved? The outcome of this will determine how graphical the interface needs to be, i.e. using pictures on buttons and illustrating some of the available commands with photos.
2. What language groups are involved? The language groups will determine in what languages the interface needs to be available.
3. Do the communities have access to computers? One of the most common technologies in Africa today is the cellular phone. In 2002, thirty five percent of South African households had access to a cell phone, but in 2007, that percentage had increased to seventy eight percent. This is almost the same percentage as for radios, which is seventy nine percent (Stats SA, 2008:44).If a GUI is created, would it not be better (from a community perspective), to have access via a cell phone interface or a sms based system as well as a computer? The possibility of installing computers in the communities exists, but once the computers are there, who will maintain and upgrade them, who will help the community if the system crashes?
4. Does the specific community have access to electricity?

All these questions will have to be investigated. The data capturers, field workers, transcribers, and translators will use computers and will need a GUI,

as they will almost certainly be city or small town dwellers with access to electricity and computers.

Finally, the accessibility of the database for indigenous communities is a vital aspect that will need further study. Some challenges will be as follows:

a. One needs to design and develop a GUI that is user friendly enough for communities to use. This will mean that the concepts must be simple and accessible to these communities.
b. The communities will need to be educated on how to use the chosen technology. Technology can alienate communities if the use thereof is not conveyed to them properly. If however the technology is incorporated to satisfy the communities' specific needs and the technology can be shown to be a useful tool, alienation might not occur.
c. Community access points such as a libraries, clinics, and community halls need to be investigated in order to identify the best location for giving the community access and conveying information needed to them.

5.5 CONCLUSION

The process of the study included the following: the importance and need for a well designed IK database in South Africa, the significance of a template IK database for researchers, how communities are currently being affected, and the purpose of the KM framework.

In conclusion, the goal of the study has been to put in place a KM framework and to design a prototype or template IK database for users to have a start when working in the field of IK. This is not to say that the information will work in all circumstances. It is important that procedures be in place to protect the communities. Above all, the communities should not be exploited. A goal kept

in mind throughout the design was the importance of a well-designed database that can be expanded as needed. Simplicity and ease of use was earmarked as important factors.

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ADDENDUM 1

Knowledge Management: A Threefold framework

Survey and Results

SURVEY

A survey was conducted to assess the threefold frame-work in terms of its completeness, accuracy, clarity, and conciseness.

TABLE 1

The need for a KM framework: Survey respondents' comments about the need for a KM framework

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The framework is important for the practical & theoretical structure it can provide. It can provide a context for all work in the field.

It is important to create (or begin the process of converging on) a consensual definition of the phenomenon so that we can begin to perform "normal science" and start to coordinate accumulated research.

A framework helps people understand what KM is, what knowledge activities are involved and how the knowledge activities affect organizational effectiveness. Most of the confusion about knowledge management results from the lack of a comprehensive framework.

This framework gives academicians and practitioners a common set of well-defined constructs for research and practice in KM.

A framework can help place people's efforts in a bigger perspective. It can also help both practitioners and researchers have a way to identify if they have covered all the appropriate issues pertaining to their situation.

For (a) awareness and understanding, (b) common communication, (c) scoping of initiatives and projects, (d) further development of the field. It is especially important at this early stage in the development of the practice and theory of KM to be able to discuss what it is and "is not"; what entities and activities it is concerned with (as you have done). The importance of models and frameworks in the communication of subtle issues, such as one involved in KM, can hardly be overstated.

A framework facilitates communication.

It is also extremely useful to have a common and understood vocabulary.

A beginning for purposeful research in an emerging area.

(1) Need to be able to define for students the range of activities that they will be prepared for, if they concentrate in KM. (2) Clarifies what people mean when they talk about KM and intellectual property. (3) Reveals the "culture" of KM-ers to those of us who study this "information renaissance" as a social phenomena.

You must be able to visualize it in order to manage it and continuously improve it. Managing knowledge is not new—what is new and exciting is the development of a framework and language that allows us to talk/study it.

Much confusion exists surrounding the notion of knowledge management. Most of this is based on a lack of clarity with respect to the definition and domain of KM. A framework is needed that defines the boundary of KM as well as its components.

We tend to have (create) tacit frameworks, so an explicit one helps in reflection and communication in a wider circle.

(1) Determines scope of action/management. (2) Acts as visual support to aid communications. (3) Can be a diagnosis/resource allocation tool.

To understand how big a problem is and that it is necessary to consider it in global dimension.

To identify all resources, actors and influences involved in the process. Framework helps to understand all (quite all) facets of KM to make a difference between true KM and just marketing keywords.

The KM label is being applied to everything and anything by consultants and "scholars" looking to get in on the hottest issues of the day. We need to reclaim the concept and provide some influential foundation, rigor, and consistency. On the other hand, we must realize that something as basic and fundamental as knowledge cannot be captured by a single view.

It matters not what framework or architecture you use, but having one enables systematic knowledge identification and leverage.

The experience I have with my clients is that until they have a coherent vision (the perspective based on an overall framework model), they cannot focus on priorities, identify how to coordinate cross-organizational efforts, [focus] on identifying overall long-term benefits.

Survey results indicate an appreciable of success for these criteria. They also suggest the possibility of future enhancements. Future investigations will determine the extent to which the threefold framework serves to unify viewpoints and ideas in the field, the degree of its descriptive power, its utility in the generation of KM theory and research hypothesis, its value as a guide to considerations that practitioners need to address, and its contribution as a stepping stone in the stimulation of future KM frameworks.

SURVEY AND RESULTS

Aside from conceptual justification for the framework, survey results provide external validation. A list was compiled of contributors to the KM literature, presenters at KM conferences, and faculty who designate KM as a major research area. Each of the 122

persons on this list received the framework description as presented in this paper, plus a questionnaire. Of the 31 respondents, 13 identified themselves as researchers, 13 as practitioners, and the rest as both researcher and practitioner. Respondents were asked to assess each of the three framework components on four criteria: completeness, accuracy, clarity, and conciseness. Their perceptions regarding the overall framework were also captured by asking how satisfied they were with the overall framework and the extent of the framework's success in providing a unified and comprehensive view of KM phenomena. These perceptions were gathered using Likert-scale items and clustered into three categories: low, medium, high. For instance, responses indicating no success to slight success form the low category; those in the somewhat successful to moderately successful range form the medium category; responses in the successful to extremely successful range belong to the high success category. In addition to scaled items, respondents were also asked to provide observations on the need for a KM framework (responses were shown earlier in Table 1).

Distributions of responses are presented in Figures 1 and 2. Figure 1 shows frequency distributions of responses concerning the overall framework. The respondents are nearly unanimous in their perception that it is highly important to have a KM framework. Overall satisfaction with the threefold framework was indicated to be medium or high by over 80% of the respondents. Similar results were obtained for the framework's success in providing a unified view and a comprehensive view of the main factors involved in KM.

Figure 2 shows frequency distributions of responses on the four criteria for each of the framework's three components. For each of the 12 assessments, at least 70% regard the framework as in the medium to high success categories. The mode is high success for 9 of the 12 and medium success for the other three assessments. On the whole, these results are supportive of the framework, but do suggest that future modifications to the framework should focus on enhancing the accuracy and clarity of the resource component and the completeness of the activity component.

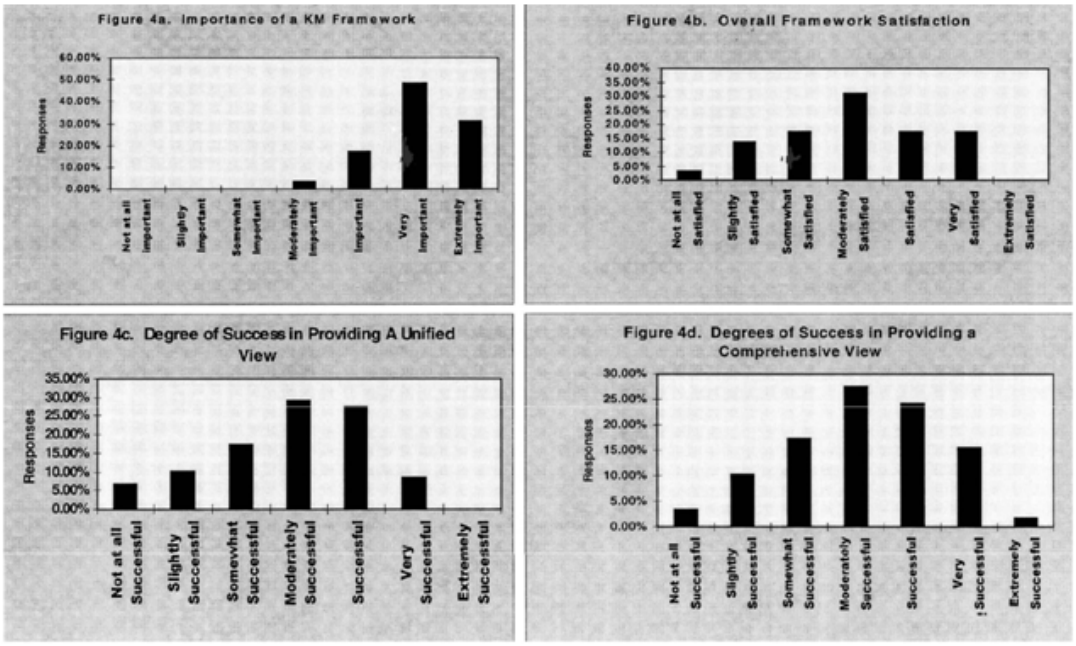

Figure 1 Responses concerning the overall framework

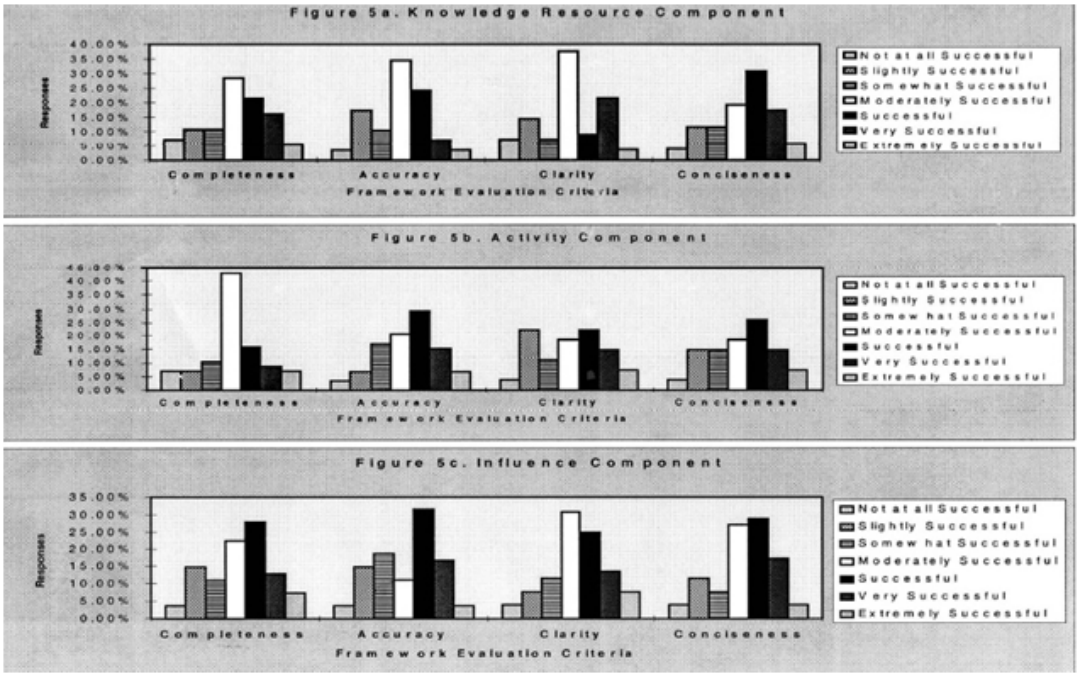

Figure 2 Responses for each of the framework's component

ADDENDUM 2

Schematic of:

Existing KM Frameworks

BROAD FRAMEWORKS					
Authors	**Wiig (1993)**	**Leonard-Barton (1995)**	**Arthur Andersen & APQC (1996)**	**Choo (1996)**	**Van der Spek Spijkervet (1997)**
Focus	Identify management influences on the conduct of KM.	Manage interaction between organisation's technological capabilities and knowledge development activities.	Provide a basis for benchmarking the conduct of KM within and between organisations.	Describe the working of "knowing" organisation.	Characterise conceptualise-reflect-act-retrospect cycle for governing the conduct of KM.
Roots/ Origin	Not indicated.	Field research.	Consulting experiences.	Synthesis of past research.	Not indicated.
Knowledge Resources		See Table 2.2			
Knowledge Manipulation Activities	See Table 2.3	See Table 2.3	See Table 2.3	See Table 2.3	See Table 2.3
Influences on Conduct of KM	See Table 2.4	See Table 2.4	See Table 2.4		See Table 2.4

SPECIALISED FRAMEWORKS					
Authors	**Sveiby (1997)**	**Petrash (1996)**	**Nonaka (1996)**	**Szulanski (1996)**	**Alavi (1997)**
Focus	Characterise and measure intangible assets (especially knowledge).	Characterise and measure intellectual capital.	Characterise knowledge creation through interaction of tacit & explicit	Identify barriers to transferring best practices within an organisation.	Using technology to accomplish KM at KPMG Peat Marwick.

			knowledge and among individual group, and organisational entities.		
Roots/ Origin	Consulting experiences.	Practical experiences.	Not indicated.	Synthesis of past research & an empirical study.	Case study.
Knowledge Resources	See Table 2.2	See Table 2.2			
Knowledge Manipulation Activities			See Table 2.3	See Table 2.3	
Influences on Conduct of KM			See Table 2.4		

Table 1 Comparative Summary by Holsapple and Joshi (1999)

AUTHOR	KNOWLEDGE RESOURCES
Leonard-Barton (1995)	1. Employee knowledge; and 2. Knowledge embedded in physical systems.
Sveiby (1997)	1. External structures; 2. Internal structures; and 3. Employee competencies.
Petrash (1996)	1. Human capital; 2. Organisation capital; and 3. Customer capital.

Table 2 Summary of Knowledge Resources Identified in the Frameworks by Holsapple and Joshi (1999)

AUTHOR	KNOWLEDGE MANIPULATION ACTIVITIES
Leonard-Barton (1995)	1. Shared and creative problem solving; 2. Importing and absorbing technological knowledge from the outside of the firm; 3. Experimenting and prototyping; and 4. Implementing and integrating new methodologies and tools.
Arthur Andersen and APQC (1996)	1. Share; 2. Create; 3. Identify; 4. Collect; 5. Adapt; 6. Organise; and 7. Apply.
Wiig (1993)	1. Creation; 2. Manifestation; 3. Use; and 4. Transfer.
Choo (1996)	1. Sense making (includes: information interpretation); 2. Knowledge creation (includes: information transformation); and 3. Decision making (includes: information processing).
van der Spek and Spijkervet (1997)	In the act process 1. Develop; 2. Distribute; 3. Combine; and 4. Hold.
Nonaka (1996)	1. Socialisation (conversion of tacit knowledge to tacit knowledge); 2. Internalisation (conversion of explicit knowledge to tacit knowledge); 3. Combination (conversion of explicit knowledge to explicit knowledge); and 4. Externalisation (conversion of tacit knowledge to explicit knowledge).
Alavi (1997)	1. Acquisition (knowledge creation and content development); 2. Indexing; 3. Filtering; 4. Linking; (activities 2, 3 and 4 involve screening, classification, cataloguing, interacting, and interconnecting internal and external sources); 5. Distributing (packaging and delivery of knowledge in form of web pages); and 6. Application (using knowledge).
Szulanski (1996)	1. Initiation (recognise knowledge need to satisfy that need); 2. Implementation (knowledge transfer takes place);

	3. Ramp-up (use the transferred knowledge); and 4. Integration (internalise the knowledge).

Table 3 Summary of Knowledge Manipulation Activities Identified in the Frameworks by Holsapple and Joshi (1999)

AUTHOR	INFLUENCES ON THE CONDUCT OF KNOWLEDGE MANAGEMENT
Leonard-Barton (1995)	1. Managerial systems (e.g. education, reward, and incentive systems); and 2. Values and norms (e.g. system of cast and status, rituals of behaviours, passionate beliefs).
Arthur Andersen and APQC (1996)	1. Culture; 3. Measurement; and 2. Leadership; 4. Technology.
Wiig (1993)	1. Exploring knowledge and its adequacy (survey & categorise knowledge, analyse knowledge & related activities, elicit, codify, & organise knowledge); 2. Assessing value of knowledge (appraise & evaluate knowledge and related activities); and 3. Managing knowledge activities (synthesise knowledge related activities; handle, use, and control knowledge; leverage, distribute, automate knowledge).
van der Spek and Spijkervet (1997)	1. Conceptualise (gain insights about the conduct of KM); 2. Reflect (access qualities and plan improvements); 3. Retrospect (evaluating the performance of the knowledge manipulation activities and the result from those activities); 4.Internal developments (culture, employee motivation, organisational, adjustments, management, technology); and 5. External developments.
Szulanski (1996)	1. Characteristics of knowledge transfer (includes casual ambiguity and unproveness); 2. Characteristics of knowledge source (includes lack of motivation, perceived unreliability); 3. Characteristics of knowledge recipient (includes lack of motivation, absorptive and retentive capacity); and 4. Characteristics of the context (includes barren organisational

	context and arduous relationship).

Table 4 Summary of Knowledge Management Influences Identified in the Frameworks by Holsapple and Joshi (1999)

SYSTEM APPROACH FRAMEWORKS				
	Holsapple and Joshi (2002)	**Jarrar (2002)**	**Gore and Gore (1999)**	**Wiig *et al.* (1997)**
Structure				
Plan	Set generic description of an organisation's knowledge resources. Define elemental knowledge manipulation activities an organisation performs. Identify major influences that impact an organisation's conduct of KM (Holsapple *et al.*, 2004).	Set strategic priority and define and understand knowledge.	Formulate vision.	Conceptualise and reflect.
Execute	-	-	-	Act
Evaluate	-	-	-	Review
Knowledge types/ resources	Knowledge embedded in participants, culture, infrastructure, artefacts, purpose and strategy.	-	Tacit knowledge and explicit knowledge.	-
KM processes/ activities	Acquire, select, internalise, and use knowledge.	Collect, present, distribute, and measure	Mainly focuses on knowledge creation and externalisation.	Develop, distribute, combine, and consolidate

		knowledge.		knowledge.
KM influences/ factors	Resource influences; Managerial influences; and Environmental influences.	Knowledge environment.	-	External and internal developments.
'-', not indicate or not clearly indicated.				

Table 5 Comparisons of systems approach frameworks by Wong and Aspinwall (2004)

STEP APPROACH FRAMEWORKS		
	McCampbell *et al.* (1999)	**Wigg (1999)**
Structure		
Plan	Form powerful coalition; Communicate vision of KM; Establish teams for needs assessment; and Analyse the needs of KM.	Obtain management buy-in; Survey and map the knowledge landscape; Plan the knowledge strategy; Create and define knowledge-related alternatives and potential initiatives; Set knowledge management priorities; and Determine key knowledge requirements.
Execute	Identify and collect knowledge; Design a technological structure; Test the technology; Maintenance of the technology; Retest the technology; Training of knowledge workers; Roll out the use of KM practices; and Make systems go live.	Acquire key knowledge; Create integrated knowledge transfer programmes; Transform, distribute, and apply knowledge assets; Establish and update a KM infrastructure; Manage knowledge assets; Construct incentive programmes; Coordinate KM activities and functions enterprise-wide; and Facilitate knowledge-focused management.
Evaluate	Track usage; Measure quality and productivity; Measure the performance of KM practices; and Conduct a need assessment review.	Monitor knowledge management.
Knowledge	Internal knowledge; and	Can be inferred from the step:

types/resources	External knowledge	'manage knowledge assets'.
KM processes/activities	Identify and collect knowledge.	Acquire, transform, distribute, and apply knowledge.
KM influences/factors	-	Can be inferred from the steps: 'construct incentive programmes' and facilitate knowledge-focused management'.
'-', not indicated or not clearly indicated.		

Table 6 Comparisons of step approach frameworks by Wong and Aspinwall (2004)

HYBRID APPROACH FRAMEWORKS		
	Rubenstein-Montano *et al.* (2001)	**Mentzas (2001)**
Structure		
Plan	Strategise and Model	Awareness and Plan
Execute	Act and Transfer	Develop Operate
Evaluate	Revise	Measurement
Knowledge types/resources	Tacit knowledge; and Explicit knowledge	Knowledge assets
KM processes/activities	KM tasks	Process
KM influences/factors	Culture; Strategy; and Learning	Strategy; Structure; and System

Table 7 Comparisons of hybrid approach frameworks by Wong and Aspinwall (2004)

ADDENDUM 3

Guidelines & Worksheets

Grenier Guidelines: Research Techniques - Participatory rural appraisal (PRA) methods

&

World Bank Worksheets: Checklist for Best Practices

PRA Techniques

	TECHNIQUE	DESCRIPTION
1.	Review of secondary data	Secondary data are analysed to a large extent, but too much emphasis on previous analyses and opinions can mislead investigations.
2.	Direct observation	Observations are related to questions: What? When? Where? Who? Why? How?
3.	Do it yourself	Villagers are encouraged to teach the researcher how to do various activities. The researcher will learn how much skill and strength are required to do day-to-day rural activities, gaining an insider's perspective on a situation. Roles are reversed: villagers are the "experts" and attitudes are challenged.
4.	Participatory mapping and modelling	Using local materials, villagers draw or model current historical conditions. The researcher then interviews the villager by "interviewing the map". This technique can be used to show watersheds, forests, farms, home gardens, residential areas, soils, water sources, wealth rankings, household assets, land-use patterns, changes in farming practices, constraints, trends, health and welfare conditions, and the distribution of various resources.
5.	Transect walks and guided field walks	The researcher and key informants conduct a walking tour through areas of interest to observe, to listen, to identify different zones or conditions, and to ask questions to identify problems and possible solutions. With this method, the outsider can quickly learn about topography, soils, land use, forests, watersheds, and community assets.
6.	Seasonal calendars	Variables such as rainfall, labour , income, expenditures, debt, animal fodder or pests, and harvesting periods can be drawn (or created with stones, seeds, and sticks) to

		show month-to month variations and seasonal constraints and to highlight opportunities for action. An 18-month calendar can better illustrate variations than a 12-month calendar.
7.	Daily-activity profiles	Researchers can explore and compare the daily activity patterns of men, women, youth, and elders by charting the amount of time taken to complete tasks.
8.	Semi-structured interviewing	A semi-structured interviewing and listening technique uses some predetermined questions and topics but allows new topics to be pursued as the interview develops. The interviews are informal and conversational but carefully controlled.
9.	Types, sequencing, and chain interviews	Individual, pair, and group interviews are combined in a sequence to take advantage of key informants and specialist groups.
10.	Permanent-group interviews	Established groups, farmers' groups, or people using the same water source can be interviewed together. This technique can help identify collective problems or solutions.
11.	Time lines	Major historical community events and changes are dated and listed. Understanding the cycles of change can help communities focus on future actions and information requirements.
12.	Local histories	Local histories are similar to time lines but give a more detailed account of how things have changed or are changing. For example, histories can be developed for crops, population changes, community health trends and epidemics, education changes, road developments, and trees and forests.
13.	Local researchers	With some training, local people can conduct the research process (for example, collect, analyse, use, and

	and village analysts	present data; conduct transects; interview other villagers; draw maps; make observations).
14.	Venn diagrams	To show the relationship between things, overlapping circles are used to represent people, villages, or institutions; lines are added to reflect inputs and outputs.
15.	Participatory diagramming	People are encouraged to display their knowledge on pie and bar charts and flow diagrams.
16.	Wealth and well-being rankings	People are asked to sort cards (or slips of paper) representing individuals or households from rich to poor or from sick to healthy. This technique can be used for crosschecking information and for initiating discussions on a specific topic (for example, poverty). The technique can also be used to produce a benchmark against which future development interventions can be measured or evaluated.
17.	Direct-matrix pair-wise ranking and scoring	Direct-matrix pair-wise ranking and scoring is a tool used to discover local attitudes on various topics. People rank and compare individual items, using their own categories and criteria, by raising hands or placing representative objects on a board. For example, six different shrubs can be ranked from best to worst for their fuel, fodder, and erosion-control attributes. Other resources can be ranked in terms of taste or marketability. Wealth ranking can be used to identify wealth criteria and establish the relative position of households.
18.	Matrices	Matrices can be used to gather information and to facilitate or focus analyses and discussions. For example, a problem-opportunity matrix could have columns with the following labels: soil type, land use, cropping patterns, and available resources; and rows with the following labels: problems, constraints, local solutions, and initiatives already tried.

19.	Traditional management systems and local-resource collections	Local people collect samples (for example, of soils, plants). This can be an efficient way to learn about the local biodiversity, management systems, and taxonomies.
20.	Portraits, profiles, case studies, and stories	Household histories or stories of how a certain conflict was resolved are recorded. This can provide short but insightful descriptions of characteristic problems and how they are dealt with.
21.	Key probes	A question addressing a key issue is asked of different informants, and the answers are compared. The question might be something like “If my goat enters your field and eats your crops, what do you and I do?”
22.	Folklore, songs, poetry, and dance	Local folklore, songs, dance, and poetry are analysed to provide insight into values, history, practices, and beliefs.
23.	Futures possible	People are asked how they would like things to be in one year and to predict what will happen if nothing is done or if something is done. People’s desires, wishes, and expectations are revealed.
24.	Diagrams exhibitions	Diagrams, maps, charts, and photos of the research activity are displayed in a public place to share information, facilitate discussions, and provide an additional crosschecking device. The exhibition can inspire other villagers to take part in research activities.
25.	Shared presentations and analysis.	Participants are encouraged to present their findings to other villagers and to outsiders, providing another opportunity for crosschecking, feedback, comment, and criticism.
26.	Night halts	The researchers live in the village during the research process. This facilitates all interactions between the outsiders and the villagers, invites change in the

		outsiders' attitudes, and allows for early-morning and evening discussions, when villagers tend to have more leisure time.
27.	Short questionnaires	Short and issue-specific questionnaires can be useful if conducted late in the research process.
28.	Field report writing	Key findings are recorded before "leaving" the village. (This assumes that the community has consented to having the research data leave the village.) Brief summaries are made of each diagram, model, and map, as well as of the process involved in creating them.
29.	Self-correcting field notes	Field notes help the researcher remain focused on what has been done, what was learned through the exercise, and what has been done. Researching the field notes on a regular basis helps the researcher correct errors and identifies problems and solutions.
30.	Survey of villagers' attitudes toward PRA	To improve the PRA process and techniques and maintain realistic expectations, the researcher asks the villagers what they expected and what they learned from the PRA research process.
31.	Intriguing practices and beliefs	Indigenous practices and beliefs are noted, even if they are based on myth or superstition. Even practices that are unusual or do not fit in with conventional scientific thinking are worth exploring because they are meaningful to local people.

Worksheets
Checklist of Best Practices

INDIGENOUS PEOPLES, PROPONENTS, NGOS, AND GOVERNMENTS

Reminders about Traditional Representation

When you are trying to ensure that the indigenous peoples and their traditional knowledge are included, here are few things to think about:

Encourage the local indigenous community to develop a representative group on the basis of skills. What about establishing an NGO or indigenous knowledge centre?

Consider liaison to neighbouring communities?

Suggest a network of communications and discussions established amongst indigenous communities and proponent. Establish local communities of practice or practitioners (i.e. let the experts talk to each other, the traditional healer with the medical doctor, the herbalist woman with the botanist, etc.)

Within the joint ventures or participatory research, are team members assigned from the indigenous community?

Will time and work be remunerated? How have the local indigenous peoples participated in establishing a fair compensation?

Will the indigenous peoples feel they can influence the project so as to set their own priorities with respect to land and resources?

Are women and their special skills and knowledge specifically included on the team and in a culture-sensitive manner? If there can be no direct contact between men and women, do you have women ready on your own staff to be the contact people?

Provide for participatory impact monitoring and evaluation ensuring that the perspective of traditional knowledge is part of the assessment.

Consider formal or informal partnerships or joint venture agreements with the indigenous community.

Invite the indigenous community to begin joint classification of land use, joint assessments of impacts, joint decision-making.

Establish some form of equity share or joint venturing in the project between the traditional community and the project if it is appropriate.

Ensure that local, non-indigenous communities are included in the project planning and implementation, but distinguished from indigenous communities.

Are other stakeholders identified and represented as distinct from the indigenous groups?

Will the discussions and negotiations use some form of round table, community mentors, or other means? Check in the detailed guidelines for a range of participatory techniques.

Project Design Reminders

Are the traditional knowledge holders who will be working with the project credible experts in the opinion of the indigenous community?

Have the community and proponent settled on a way to make joint decisions?

Does the indigenous group need to establish a legal entity, such as a representative NGO to have the capacity to engage in negotiations?

Will the traditional knowledge system become part of the final decision-making? If there is a difference in findings between the traditional methods and the project's determinations, how will these be resolved? Will indigenous knowledge be seen as an equivalent to scientific methods?

How will the two knowledge systems be integrated – is the entire system equitable? Are there people available who have the capacity to bridge the cultural and knowledge system differences? If not, how will you build the capacity?

Does the project plan to provide the community with a science/management interpreter/advisor, if it wishes to have one?

How will the project be described to the community in terms that the indigenous people can understand?

After the project has become operational, how will the project assess if the community fully understood the project and its implications?

Traditional Rights Reminders

What processes have you set up to handle intellectual property rights?

Have you assessed the impact of traditional rights to resources and how this will affect the project?

Have all the land ownership issues been settled?

Have you made sure that the traditional people are satisfied that they will suffer no loss of rights without appropriate compensation?

Have you arranged structured agreements for accessing traditional knowledge?

What mechanisms have you put in place to ensure that the community is empowered through meaningful consultations, capacity-building, and capacity-maintenance?

What will you do to ensure that community knowledge is treated with equity and respect?

Risk Analysis Reminders

What steps have you taken to prevent the societal impact of alcohol, drugs, and disease?

How will you invite community participation in identifying potential risks to the traditional community from direct impact on the environment?

Have you considered a joint cost-benefit analysis, or joint assessments of impact?

How will you and the community measure the project's level of sustainability in the planning stages, and after the project is operational? What mechanisms are present for the local indigenous community to understand the objectives of the other major stakeholders (the investors, planners, managers, other communities) in the long term?

Preliminary Reminders Before You Start

Have you checked for the presence of indigenous peoples?

- Use the simple definition: indigenous peoples are self-identifiable as a people, wholly or partially self-governed, and live within a larger nation.

Have you been sensitive to the nature of indigenous knowledge?

- Recognize that traditional knowledge is a way of life, an experience-based relationship with family, spirits, animals, plants, and the land, an understanding and wisdom gained through generations of observation and teaching that uses indirect signals from nature or culture to predict future events or impacts.

Have you been careful to incorporate indigenous peoples and their traditional knowledge systems as full partners in the design of a project when traditional people are directly or indirectly affected by the project?

Do you remember the four guiding principles on acquiring traditional knowledge?

- Cause no harm.
- Define the roles and responsibilities of participants carefully and in line with culture and knowledge systems.
- Define the information to be collected; specify what information is proprietary and not to be shared.
- Establish the use, ownership of information, and the means to interpret or communicate it at the outset.

Do you know the key aspects of a relationship with indigenous peoples?

- *Respect*
- *Trust*
- *Equity*
- *Empowerment*

Have you respected intellectual property rights derived from traditional knowledge?

- Build in opportunities for indigenous peoples to benefit directly and equitably from commercial products derived from their traditional knowledge.

How did you handle proprietary traditional knowledge?

- Allow indigenous peoples to define which parts of their traditional knowledge are for public consumption and which are private and confidential.
- Ask where the development would best take place; do not ask where development should not take place.

How should you handle access to natural resources for indigenous peoples?

- Respect and protect traditional rights to natural resources. Ensure that traditional access routes and places for hunting, fishing, and harvesting are undisturbed.

Have you taken into account the most common reactions among indigenous peoples to development projects?

- Recognize that indigenous peoples feel that they belong to the land, so they may not easily accept changing it, or

their relationship to it, in any radical way.

- Engage traditional knowledge systems before initial decisions have been taken to help predict the impacts of a project. Be prepared to abandon the project or vastly modify it if there is a risk of harm to indigenous peoples.
- You may be interested in how to make the project work, but they are interested in whether the project should even start.

Avoid a strategy of including indigenous peoples too late or in a trivial manner; it places both the traditional people and the project at risk.

- Local indigenous people will want to be sure they have the authority to halt a project if the potential damage to the community is unacceptable.

Developing a positive relationship with indigenous peoples requires sensitivity. Have you thought about how this should be done?

- Understand the local customs and etiquette and train staff who will interact with indigenous peoples before contact.

How have you gone about including local indigenous people and their knowledge in the decision-making process?

- Make the participatory approach fit the cultural sensitivity of the traditional community.
- Successful strategies variously include round tables or talking circles, training the trainers, co-management, and participatory action research.
- Participation by indigenous peoples as autonomous groups is an essential ingredient to developing both mutual understanding and consensus to set strategic objectives, define a chain of expected results, identify underlying assumptions and risks, and select appropriate performance indicators.

Have you remembered to develop a comprehensive plan for meshing traditional and other methods?

- Include traditional knowledge early and as a complement to scientific or Western approaches.
- Leave broad margins for error in predictive models, and include the socio-economic costs of the often invisible economy of “women’s work” and the special vulnerability that traditional women face.
- Include indigenous knowledge systems in both the interpretation of the knowledge and in its implementation in the program design by relying on credible traditional knowledge holders. These people can bring traditional concepts of self-sustainability to the project.
- Assess the credibility of sources of traditional knowledge by using the community as a source of credentials.
- Using science and traditional knowledge together in co-management or participatory action research can be a powerful tool to improve the effectiveness of projects, but it requires a relationship based on trust and respect for each other’s information and for the different methodologies used.
- Protocols for acquisition of traditional knowledge should be defined by the traditional community and agreed to by all parties.

Have you scheduled work using traditional methods of time-keeping?

- Instead of using time scales in project planning, it is sometimes better to use indicators based on the traditions of traditional people such as harvest times, festivals, and hunting or fishing seasons.

What about working within another country's rules and regulations?

- Understand the host jurisdiction's laws and regulations regarding indigenous peoples including constitutional rights, relevant legislation, policy statements, and recent practices.
- ILO 169 recommends that no government incorporate discriminatory practices with regard to indigenous people. Where this has not been done, build the development project program design so that indigenous peoples benefit in an equitable fashion to other stakeholders.

What will you do if the traditional people would like to be paid?

- If they would like money, engage traditional knowledge practitioners the same way you would engage scientists and other professionals.
- Non-monetary, innovative ways of payment can also include training opportunities, construction of infrastructure such as schools and hospitals, or there may be something that the local community would like that is special for them -- ask and see what they would like.
- Build in safeguards to protect traditional communities that are extremely vulnerable to unfair exploitation because of lack of experience with, or non-acceptance of, monetary-based systems of resource sharing.

Capacity Building and Capacity Maintenance Reminders

Encourage a socio-economic capacity needs-analysis be carried out.

Arrange for quality translation.

Consider capacity-building workshops or training programs for both indigenous peoples and for project staff.

Build in mechanisms for sustaining the skills and knowledge capacity acquired during the project.

Ensure financial assistance is provided so that participation will be possible by indigenous peoples?

Build in mechanism to evaluate and collect evidence of indigenous peoples' participation. Use this as a means to improve the performance and interaction the next time.

Reminders about What to Do If Problems Occur

It is an ominous sign when trust disappears and confrontation replaces cooperative negotiation. Examine your own performance with the community.

Did you unreasonably expect self-financed participation by the community?

Did you consistently ignore local practices, such as traditional hunting times or sacred ceremonies, to suit your project schedule?

In consultations, did you forget (or neglect) to make sure the community understood the consequences of each decision, and the specific actions that would follow?

When confronted with a problem, did corporate managers show contempt for or disregard community opinion?

Did your staff treat traditional knowledge as a poor second compared to technological or scientific knowledge?

If you answer yes to any of these questions, you need to re-think your strategy. If you are willing to train your staff, then go back to the community and tell them of your findings and that you want to change the way you operate to better suit the community.

Reminders on How to Communicate

Has the community named its own spokesperson to media?

Does the community have a representative group or team? Have the powers and tasks of the team been decided?

What other people can step in if some members of the team must do other things in the community, or get sick, or must travel?

How will you be sure everyone in the community knows what is going on? How will you pass your own information to the media and to the proponent?

Have you made good arrangements for language translations for your community

Reminders about Responsibilities

What is the schedule, and is it set in a schedule that fits your community's needs for harvests and events?

How much time will be available for the community to react to questions?

What will you do if the amount of time is too short to gather all the answers?

Do you understand what regulations the community and the proponent will get from the government?

What regulatory agencies of government will be involved? What have you decided to do to ensure your community and the agency understand each other?

To what degree will individuals and the entire community be involved in contractual arrangements?

What resources can the regulatory agencies offer to the local community?

What resources can the local community offer to the agency to help the process?

What techniques could be used to involve the general public, and when could they be used?

Most important, what techniques would your community like to see to ensure that your knowledge and expertise is used most effectively in the decision-making part of the project? How many people should represent the community for traditional knowledge and for other aspects like financing and organizing people?

Reminders about Getting a Technical Summary

What is this project all about, what is it going to use, why is it here, and not somewhere else?

What is the complete schedule of the project, with dates for each major event?

What buildings or other physical facilities will be built? What about sewers, clearing forest areas, digging holes, or quarries or trenches?

What is the total area of land to be affected directly and indirectly by construction or other project activities?

How much water is to be used and is there any way to recycle all the water?

Why was this location chosen, and what other locations were considered?

How big is this project, both in its development and construction phases?

Once it is completed and operational how many workers will there be?

Are workers going to be drawn from the local community or brought in from afar?

Of the locals, how many will be in management, how many in low-paying jobs?

What obvious changes will the community see and feel?

What are the waste materials and how is the waste to be treated?

What are the planned transportation routes?

What are the current plans for post-project clean-up?

What commitments has the project already made to other organizations to take care of these aspects?

Can the community take a role in some of the operations instead of hiring outside companies to do it?

Is this completely financed? Are there partners? Can the community play an investment role?

How long will the project last — both the development and construction phase, and also the operation of the project?

Does the proponent plan for a "permanent" home in the community?

Just what is the long-term picture from the proponent's perspective?

Do the community and the proponent both feel at ease with local men and women involved in the project?

Reminders about Benefit Sharing

Do you understand how the project will make money, and how much it will earn?

- Check out the profits from similar projects by this proponent.

What portion of the profits is likely to stay in the community?

Who from the community will be employed and to do what kind of jobs? How long will the project operate? Can the community be a permanent part of the industry?

What spin-off or support services can be started up?

If the community does become dependent on the industry from the project, what will happen when the

project is finished or does not live up to expectations?

If fishing, or hunting, or traditional agriculture, will be reduced or destroyed, is the project worth it?

If the community will receive a financial package to offset the loss of other opportunities, is it enough to make up for other changes to your cultural and social traditions?

GOVERNMENT

Program of Public Consultation

Is there a political, historical, or social tie between this community and others?

What significant changes to the social, cultural, economic, political, or environmental conditions of the community have taken place recently or even not-so-recently?

What experience or participation has this community had with development projects or agencies?

Has this community ever participated in a consultation? If so, was it successful?

Who are the community leaders? Whom do they represent?

Has there been a recent change in the community leadership; if so why?

Is the community divided in its allegiance to the leaders, i.e. will you be dealing with more than one faction?

What are the political systems within the community? How are they allied to external political systems? Does the community in general approve of the project or its ideals and goals?

What are the respective roles of elders, men, women, and youth within the community?

Who is most knowledgeable about the community's biophysical, socioeconomic, and spiritual resources?

You will probably be greeted with scepticism, but persistent good behaviour will pay off.

ADDENDUM 4

Checklist

Options that could help in identifying community-based IK.

Checklist – identifying community-based IK

Brainstorming Sessions	
	Use a flip chart or index cards to collect ideas
Information Survey	
	Use a questionnaire, checklist of ideas, open-ended questions
Workshops	
	Small-group discussions and report back results
Information sessions	
	Prepare very good minutes of a meeting, highlight suggestions
Other alternatives	
	Collection information via the internet, telephone surveys, one-on-one interviews

(Brascoupé *et al.*, 2001:20)